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WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

414 Portable PATIENT MONITOR WITH OPTIONS

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

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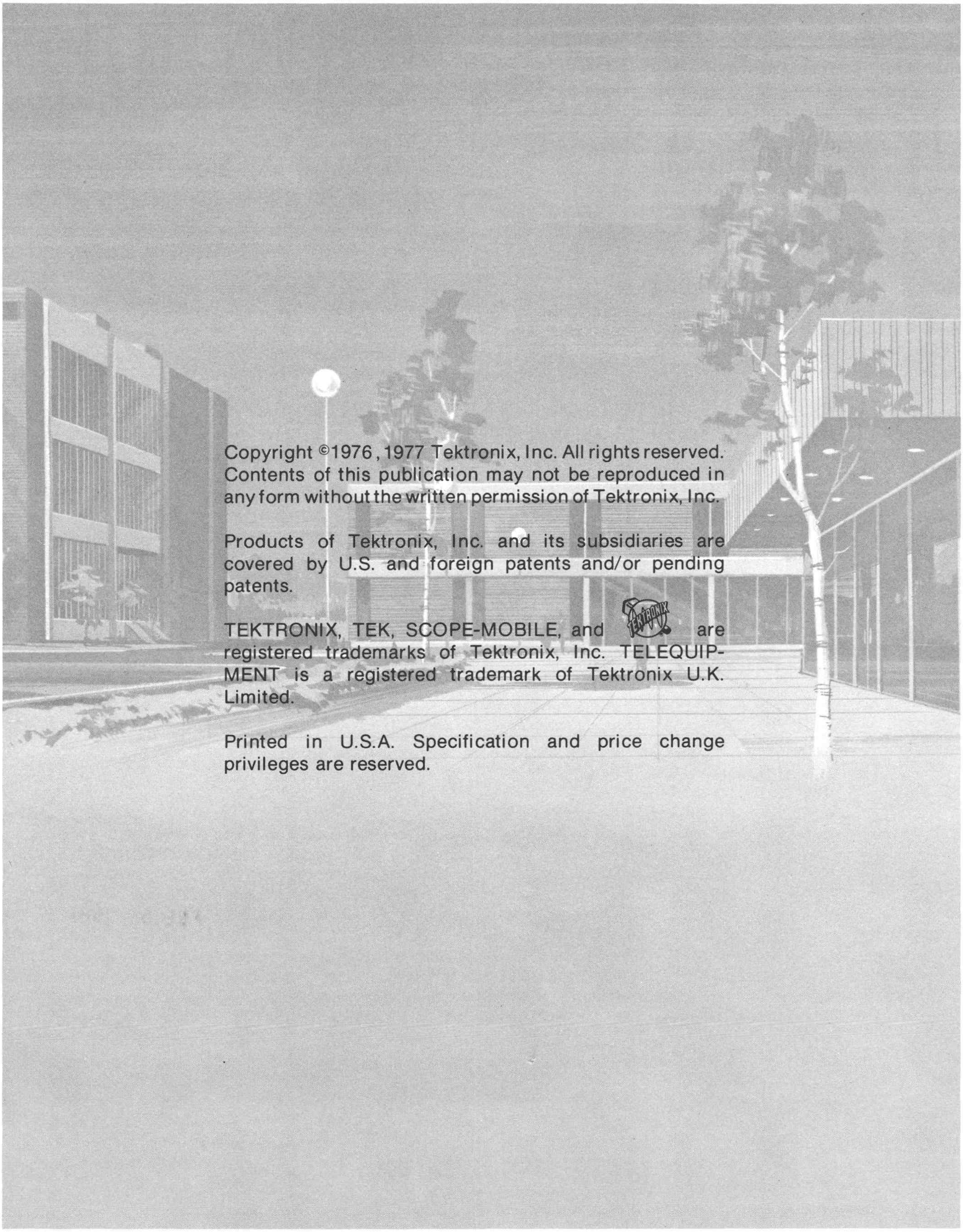


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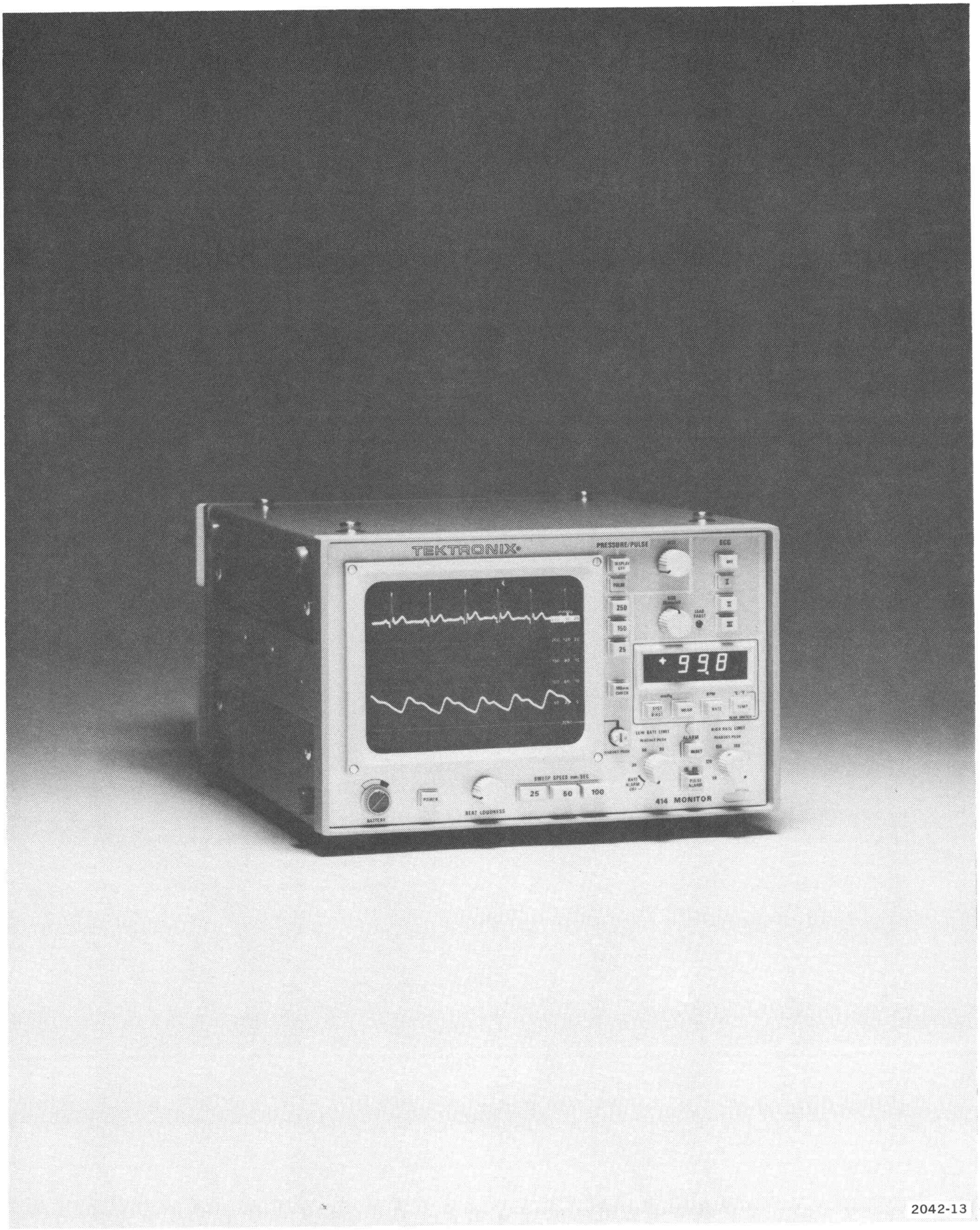
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414 Portable Patient Monitor.

GENERAL INFORMATION

INTRODUCTION

DESCRIPTION

The 414 is a portable patient monitor which displays ECG and blood pressure or peripheral pulse. Digital readout displays heart rate, systolic/diastolic blood pressure, mean blood pressure, or temperature.

The monitor can be operated from an ac power line source or the internal, rechargeable D-cell[1] battery pack.

On-location evaluation of common cable and electrode problems is provided by the ECG LEAD CHECK signal source and LEAD FAULT indicator.

A dual-trace display is provided for ECG and blood pressure or pulse. The baseline trace is automatically positioned for the mode of operation selected. Trace intensity and focus are internally preset.

Adjustable alarm limits are provided for heart rate. There are independent controls for continuous-tone-alarm loudness and for beat-tone loudness. An automatic QRS detector provides information for rate alarms, rate digital display, sweep triggering, and audible beat tone. A pulse alarm indicates pulse or pressure failure.

Other features include an anti-reflection graticule and a Hospital Grade power plug (not molded on the power cord).

SAFETY INFORMATION

The 414 monitor has fully isolated ECG circuitry and is suitable for use with electrically susceptible patients when operated from either the specific AC power source or the internal battery pack. ECG leakage current does not exceed 5 μA rms at 120 V, 60 Hz.

Electric appliances applied to a patient create hazards for both the patient and the operator unless the equipment is suitable for the application and the operator is skilled in its use. Several appliances used simultaneously compound the hazard situation. This manual contains informative and warning instructions that must be followed by the user to ensure safe operation and to retain the monitor in safe condition.

Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, leakage current and grounding requirements must be maintained.

WARNING

The monitor is not explosion proof. When used in locations with flammable anesthetics, the monitor must be at least five feet above the floor. See NFPA No. 56A, Standard for the Use of Inhalation Anesthetics, articles 24114(c) and 24032.[2]

If the monitor is dropped or severly abused, it should be checked by qualified service personnel to ensure that the safety features are intact.

High voltage inside. Do not remove covers. Operating voltage can cause injurious or fatal electric shock. Refer servicing to qualified personnel.

AC Power Source

The 414 is compatible with isolated power systems as used in operating rooms.

In non-isolated power systems, the monitor is intended to be operated from a single-phase earth-referenced power source having one current-carrying conductor (the neutral conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-phase system) is not recommended since only one conductor has fuse protection within the monitor.

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[1] An F-cell battery pack is available as an option; refer to the tabbed Option section.

[2] Safety Documents

Additional safety information can be found in the following documents:

National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts, 02110
- NFPA No. 76B, Safe Use of Electricity in Hospitals, 1973
- NFPA No. 56A, Standard for the Use of Inhalation Anesthetics, 1972
- NFPA No. 70, National Electrical Code (Article 517), 1971

Underwriters' Laboratories, Inc.
- U.L. 544, Standard for Safety, Medical and Dental Equipment

AC Power Cord and Plug

The monitor has a three-wire, #18-A.W.G. power cord and is normally supplied with a three-terminal polarized plug (Hospital Grade) for connection to the power source and safety earth. The ground (earth) terminal of the plug is directly connected to the monitor frame. For electric shock protection, insert this plug only in a mating outlet with a safety-earth contact and which is marked "Hospital Grade".

Inspect the power cord periodically for fraying, or other damage, and repair as needed. Do not operate the apparatus from ac power with a damaged power cord or plug.

Grounding

To ensure protection against electrical shock whenever auxiliary, line-operated equipment (e.g., strip-chart recorder) is electrically connected to the monitor, the monitor **must** be properly grounded. The monitor power cord provides the required ground when properly connected to a **Hospital Grade** outlet. When the monitor is connected to **other** line-operated equipment, battery operation should be avoided. If it cannot be avoided, the monitor **must** be grounded using the GND binding post on the rear panel.

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Pressure Transducers

The following pressure transducers have adequate isolation to withstand the full ac-line voltage with less than 10 μA leakage (not all transducers listed are available from Tektronix, Inc.). Pressure transducers exceeding 10 μA leakage should not be used.

Trantec 800

Gould-Statham P23 Id

Gould-Statham P50A (also designated as P50)

Bell & Howell 4-3271-0109

Pulse Sensors

The finger sensor (order Tektronix part no. 015-0236-01) and radial sensor (order Tektronix part no. 015-0237-01) meet all requirements for patient safety.

Temperature Transducers

The monitor is compatible with the 700-series temperature probes manufactured by Yellow Springs Instrument Co. These probes will withstand full ac-power-source voltage with less than 10 μA leakage. Other temperature probes should not be used.

CAUTION

DO NOT AUTOCLAVE ACCESSORIES unless the accessory manufacturer's instructions clearly approve this procedure. Many accessories can be severly damaged by autoclaving. Inherent isolation may be defeated.

1. PRESSURE TRANSDUCERS

a. All transducers recommended by Tektronix can be gas sterilized. Refer to manufacturer's instructions.

b. Pre-sterilized, disposable domes are available for some types of transducers, contact the transducer manufacturer or his representative. These domes have an integral isolation diaphragm which prevents fluid contact with the transducer and thereby eliminates the need for transducer sterilization.

2. PULSE SENSOR

Usually, pulse sensors do not require sterilization. Sensors can be cleaned by wiping with an alcohol-dampened pad.

3. TEMPERATURE SENSORS

Temperature sensors can be gas sterilized. However, adequate time must be allowed after sterilization for the ethylene oxide, which was absorbed by the plastics in the sensor, to be dissipated.

SPECIFICATIONS

The following electrical characteristics apply over an ambient temperature range of 0° to 50° C when the monitor has been calibrated in a +25° C, ±5° C environment.

TABLE 1-1
Electrical

Characteristic	Performance Requirement	Supplemental Information
ECG TRANSFER CHARACTERISTICS		
Input to Display and Input to Output		
Lead Selector	OFF, I, II, III.	
Bandwidth	0.2 Hz to 50 Hz.	
CMRR		Greater than 500,000:1 at 60 Hz with 15 kΩ maximum electrode resistance and 5 kΩ imbalance.
Input Signal DC Offset		No degradation of signals having up to 100 mV dc offset.
Overdrive Recovery	On screen within 1 second.	
Input to Display		20 mm/mV at index on SIZE knob; variable approximately X1/3 to X3.
Input to Output		
(A) TIP Contact	X1000 gain.	Within 5% for ±2.5 V linear output range. ±10 V out, maximum during overdrive conditions. Less than 100 Ω R_o, single-ended output, shortproof to ground. Load resistance 100 kΩ minimum.
(B) RING Contact	X1 gain. This output permits direct recording on a standard ECG machine or slaving one monitor to another.	Within 5% for ±2.5 mV linear output range. ±10 mV out, maximum during overdrive conditions. Less than 500 Ω R_o, single-ended output, short-proof to ground.
Isolation		
Leakage Current	Less than 5 μA rms at 120 V, 60 Hz ac.	
Self Protection		
Defibrillator and Cauterizer	Instrument may remain connected to patient during defibrillation and electrocautery when used with Tektronix patient cable.	No damage to instrument when patient cable contains 1000 Ω in series with each electrode. Resistors in cable may open in extreme cases.

TABLE 1-1 (CONT.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
QRS Detector		
R Edge Timer		Self-adjusting between 6 ms and 10 ms.
Inhibit Timer		Set to 150 ms within 25 ms.
PRESSURE		
DISPLAY OFF		Pressure transducers must be standardized to 50 mV/V/cm Hg ±1%. Pressure channel is always on when POWER switch is on except that analog information can be removed from the crt screen by pressing DISPLAY OFF.
Ranges		
250	−50 to +300 mmHg.	All three ranges can provide up to one centimeter of display for vacuum and one centimeter of display above top of marked scale.
150	−30 to +180 mmHg.	
25	−5 to +30 mmHg.	
Display Accuracy		Within 5% of full scale, analog.
Analog Output		
(A) TIP Contact	−0.5 V to +3.0 V full scale on each range.	Within 5% of full scale on each range. Load resistance 100 kΩ, minimum.
(B) RING Contact	−0.5 mV to +3.0 mV full scale on each range.	Within 5% of full scale on each range. R_o approximately 500 Ω.
Excitation	±8 V, pulsed.	Approximately 0.8 ms each cycle.
Chop Rate		Approximately 80 Hz.
Bandwidth		Dc to approximately 20 Hz.
100 mm Check	100 mmHg. Confirms system function and sensitivity.	Within 2%.
PULSE		
SIZE Control Range		Approximately 20:1.
Analog		
(A) TIP Contact		±3.0 V maximum (0.5 V/displayed cm). Load Resistance 100 kΩ minimum.
(B) RING Contact		±3.0 mV maximum (0.5 mV/displayed cm).
Overdrive Recovery		On screen within 5 seconds.
Digital Display		Blanked when SYST/DIAST or MEAN is selected.

TABLE 1-1 (CONT.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
TEMPERATURE		
Probe Compatibility	Yellow Springs Instrument Co. 700-Series Temperature probes.	
Range	-5° to $+45^\circ$ C or $+23^\circ$ to $+113^\circ$ F.	
Scale Selection	° C or ° F rear-panel switch selectable.	
ALARM LIMITS		
HIGH RATE	90-240 beats/minute. Setting can be verified on digital display.	Press limit control for digital reading. Automatically displaces other information on digital display for immediate reading.
LOW RATE	<30-150 beats/minute. Setting can be verified on digital display.	Press limit control for digital reading. Automatically displaces other information on digital display for immediate reading.
Violations	Alarm is triggered when the average rate remains outside of the selected limits for 3-15 seconds.	Rate signal output must be continuously in high or low violation between 2.7 and 17.5 seconds to allow for alarm delay to expire and cause an indication.
Pulse	Alarm is triggered when average pulsitile pressure (Systolic minus Diastolic) remains below 10-15 mmHg for 3-15 seconds or when pulse signal amplitude remains below 0.3 to 0.5 cm for 3-15 seconds.	
Alarm Output	Signal provided between ring and barrel of rear panel phone jack.	12 mA current output; voltage limited at approximately +5.5 V, +7 V maximum.
Remote Reset	Switch closure between tip and barrel of phone jack on rear panel will reset alarm.	Maximum current "sink" required: 100 μA. All alarm indicators on the 414 will be disabled unless the tip to barrel resistance attached to the ALARM jack exceeds 1 Meg Ω.
DIGITAL DISPLAY	0.33 inch high, gas discharge.	
Update Time		Between 0.75 second and 1.25 seconds except during over-range or push-to-read function.
Overrange	Warns of possible erroneous data.	Flash rate and update rate 5 Hz ±50%. Rate: Between 250 and 300 bpm, any two rate-trigger occurrences less than 200 ms apart will cause temporary overrange. Pressure: Above +3.5 V and below −0.5 V on analog signal.

TABLE 1-1 (CONT.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
Overrange (continued)		+350 mmHg & –50 mmHg (250) +210 mmHg & –30 mmHg (150) +35 mmHg & –5 mmHg (25) Temporary indication if peak violates scale ends. Temperature: Between –10° and –5° C and between +45° and +50° C (+14° and +23° F, +113° and +122° F).
Polarity	+ and – signs automatically displayed in pressure and temperature modes.	
Zero Suppression		All leading zeros are blanked except the one just preceding the decimal.
Rate		
Range	30 to 250 bpm.	
Accuracy	2% of reading or ±3 bpm, whichever is greater.	
Response	10 seconds to step function change in signal.	Within 2% of final reading.
Ripple		1 bpm at 30 bpm.
Source	ECG whenever channel is on. PRESSURE or PULSE when ECG is OFF.	
Pressure	Displays digital information independent of DISPLAY OFF switch position.	Reading appears automatically on readout for all pressure functions, except pulse. Pulse causes readout to blank.
Range	–50 to +350 mmHg. –30 to +210 mmHg. –5 to +35 mmHg (–10 to +60 mmHg in Option 21 instruments). As selected by analog display switch.	Overrange indicates if signal is beyond range limits.
Accuracy	2% of reading or ±3 mmHg whichever is greater, excluding transducer error and zero balance.	

TABLE 1-1 (CONT.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
Systolic-Diastolic	Alternates between two readings.	Cycle rate Systolic 0.9 second blank 0.1 second Diastolic 0.9 second blank 1.1 second 3.0 seconds Response is about 10 seconds to step function change. Within 2% of final reading.
Mean		Response is about 10 seconds to step function change. Within 2% of final reading. Ripple is approximately 1.0 mmHg at 30 beats per minute. SYST/DIAST Peaks must be within the selected range.
Zero	Set with front panel control. Pressing control allows zero reading to be viewed on digital display.	
Temperature		
Range	−5° to +45° C or +23° to +113° F. Rear panel switch selectable.	
Accuracy	±0.3° C or ±0.5° F over a range of +5° to +45° C or 41° to 113° F for instrument ambient temperature between +15° and +35° C. ±0.5° C or ±0.9° F over same range for instrument ambient temperature between 0° and +50° C.	With Yellow Springs Instrument Co. Series 700 probes.
Response		Within 0.1 second to step function change at probe input. Within 0.1° C or 0.2° F of final reading. However, in most cases, the thermal time-constant of the probe will be the limiting factor.
TRIGGERING		
Source	ECG if ECG channel is on, otherwise from PRESSURE/PULSE channel.	
Auto Baseline		1.8 to 9 seconds delay after last trigger (baseline in absence of trigger).

TABLE 1-1 (CONT.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
DISPLAY MODES	ECG only, PRESSURE/PULSE only, Chop between ECG & PRESSURE/PULSE.	
SWEEP		
Speeds	25, 50, 100 mm/second.	
Accuracy		Within 5% of reading, rated against heart rate scale of 35 to 120 beats/minute on 50 mm/SEC range, +15° to +35° C.
Triggering	25 mm/second free-run, 50 mm/second & 100 mm/second triggered.	
AUDIO		
Alarm	Continuous Tone.	Approximately 2 kHz.
Beat	Burst of same tone as alarm.	
Loudness	Independent controls for alarm and beat.	
ECG LEAD CHECK		
Pulse Amplitude	0.5 mV, Lead III.	Within 5%.
	1.0 mV, Lead I.	Within 5%.
	1.5 mV, Lead II.	Within 5%.
LINE VOLTAGE		
Range	115 V ac.	103.5 to 136 V ac.
	230 V ac.	207 to 250 V ac.
Frequency	48 to 440 Hz.	
AC POWER		
Current	0.35 A maximum at 115 V ac to 60 Hz.	
VA	40 VA maximum at 115 V ac to 60 Hz.	
INTERNAL BATTERY (D-cell)		
Operating Time	1.5 hours minimum with new battery.	Dual-trace mode with pulse sensor. F-cell supplied as standard after serial number B084100.

TABLE 1-1 (CONT.)
Electrical

Characteristic	Performance Requirement	Supplemental Information
INTERNAL BATTERY (continued)		
Recharge Time	Approximately 16 hours.	Charge current for F cells = 560 ± 60mA (R716 = 1.5Ω) for D cells = 300 ± 50mA (R716 = 2.2Ω)
CHASSIS CURRENT LEAKAGE	Less than 25 μA.	120 V, 60 Hz "green wire" current. Measure with 1 kΩ in path.
POWER CORD and PLUG	Plug is Hospital Grade, cord meets IEC color code requirements.	Line-brown, neutral-light blue, Safety Earth-green with yellow stripes.
Isolation, Primary to Secondary and Primary to Core		1500 V rms at 60 Hz minimum without breakdown.
CRT		
Phosphor	P7.	

TABLE 1-2
Environmental

Characteristic	Performance Requirement	Supplemental Information
AMBIENT TEMPERATURE		
Operating	0° to +50° C.	**CAUTION** *The reliability and operating life of the digital display devices may be significantly and permanently reduced if they are operated below 0° C (+32° F) for more than a few minutes. When the instrument is operating, infrequent ambient temperature excursions slightly below 0° C can be tolerated. This is due to inherent self-heating from the instrument and the device itself.* **NOTE** *Battery charging should be done in an environmental temperature between 0° and +25° C. The greater the temperature above +25° C the less charge the battery will accept, regardless of attempted compensation through extended charge time. Potential operating time will be reduced 50% or more if charging takes place in a +50° C environment.*
Storage	–40° to +60° C.	
ALTITUDE	To 15,000 feet.	

TABLE 1-3
Physical

Characteristic	Description
Weight	
414, No Battery	11 lb, 2 oz. (5.05 Kgm).
With D-Cell Battery-Pack	12 lb, 13 oz. (5.81 Kgm).
Height	5.6 inches (14.1 cm).
Including Feet and Snaps	6.0 inches (15.3 cm).
Width	9 inches (23.1 cm).
Including Handle	9.4 inches (23.9 cm).
Including Handle and Adapter	10.3 inches (25.5 cm).
Depth	10 inches (25.6 cm).
Including Cord Wraps and Knob Protrusion	11.7 inches (29.8 cm).

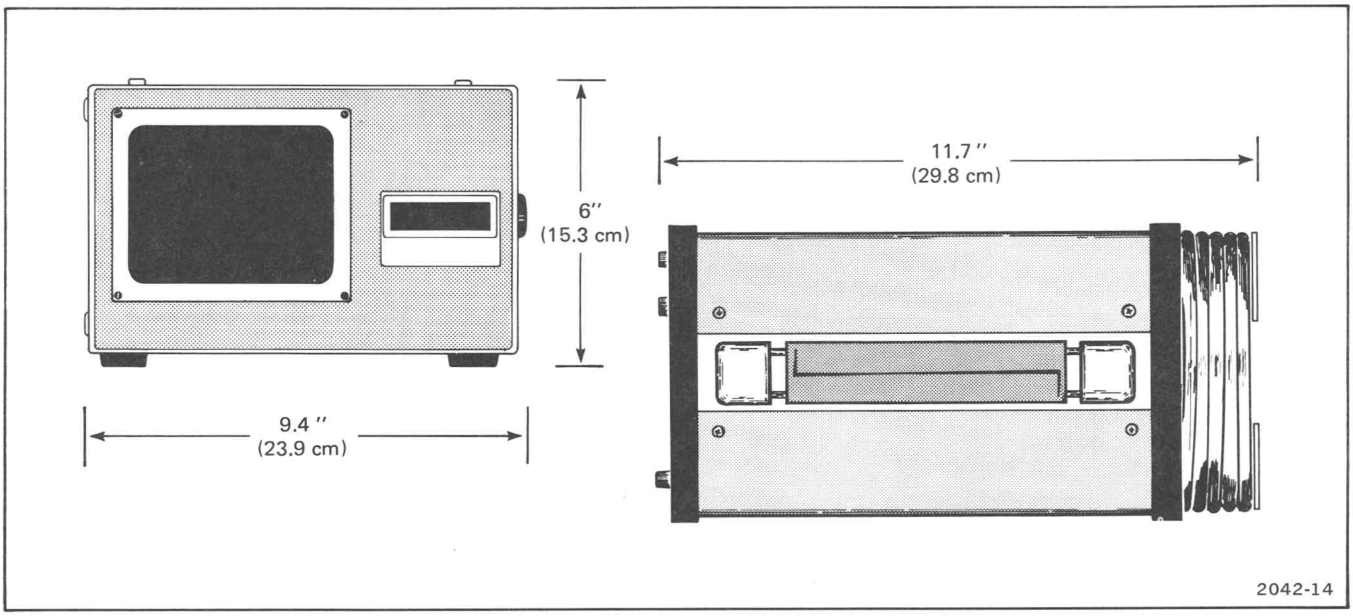


Fig. 1-1. Dimensional outline drawing.

STANDARD ACCESSORIES

The following accessories are included with the 414 Patient Monitor:

Operators Manual (1 each)
Instruction Manual (1 each)
Disposable Electrodes (3 paks of three)
Torso Cable (3 electrodes)
Electrode Wires (18 inches) w/snap fittings for disposable electrodes (2 sets)
Mounting Adapter (1 each)
Accessory Pouch (1 each)

For more detailed information, refer to the tabbed Accessories page in the back of this manual.

INSTALLATION INSTRUCTIONS

MOUNTING

The following accessories are available for mounting the 414:

Mounting Kit

Includes Mounting Stand to mount monitor at five-foot level. Attaches to vertical pipes or surfaces of anesthesia machines or similar devices.

Tektronix Part 016-0110-00

Mounting Bracket

Attaches top of Mounting Stand. Mates with Mounting Fixture below.

Tektronix Part 407-1767-00

Mounting Adapter

Attaches to monitor. Mates with Mounting Bracket above. (Included with monitor as a standard accessory.)

Tektronix Part 014-0054-00

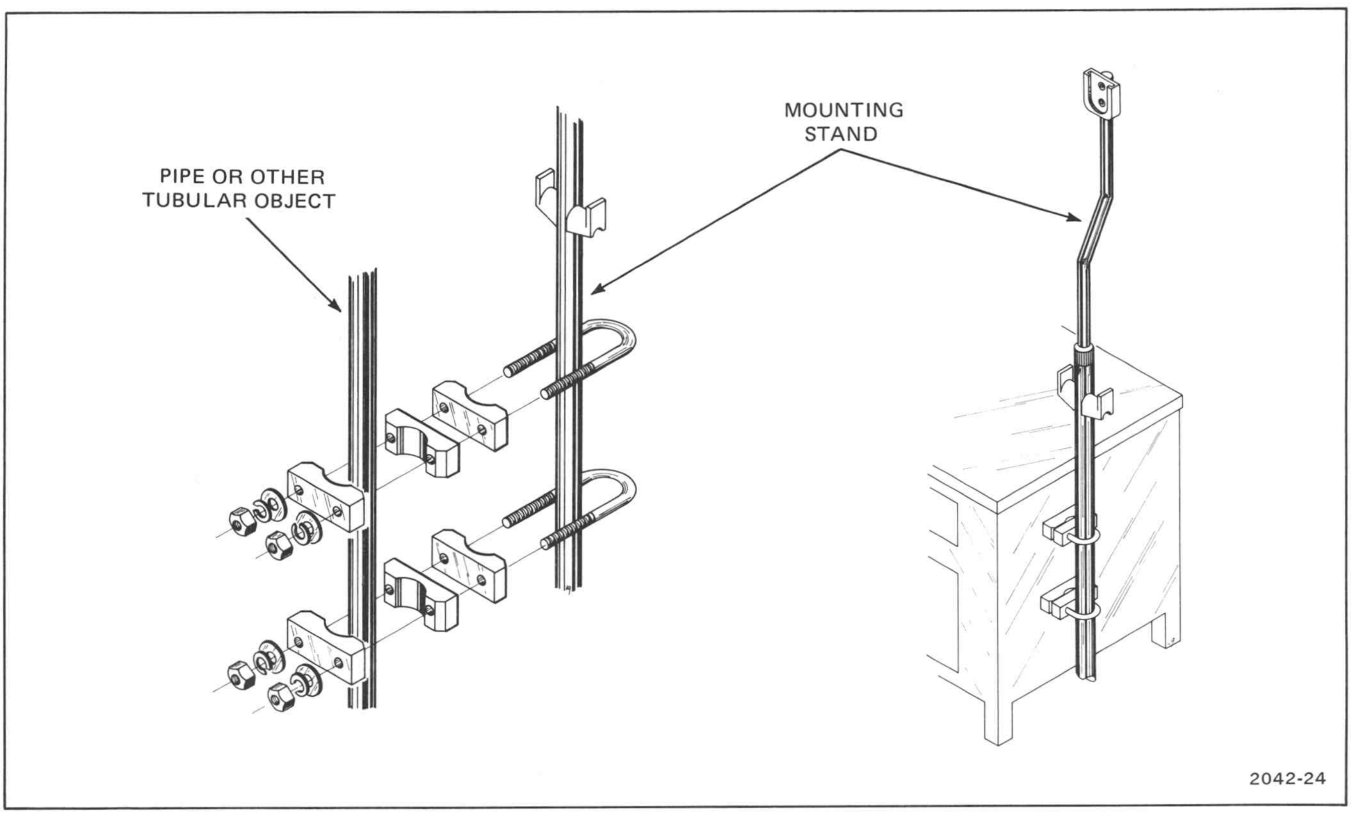


Fig. 1-2. Installing mounting stand to tubular object (pipe) or cabinet side.

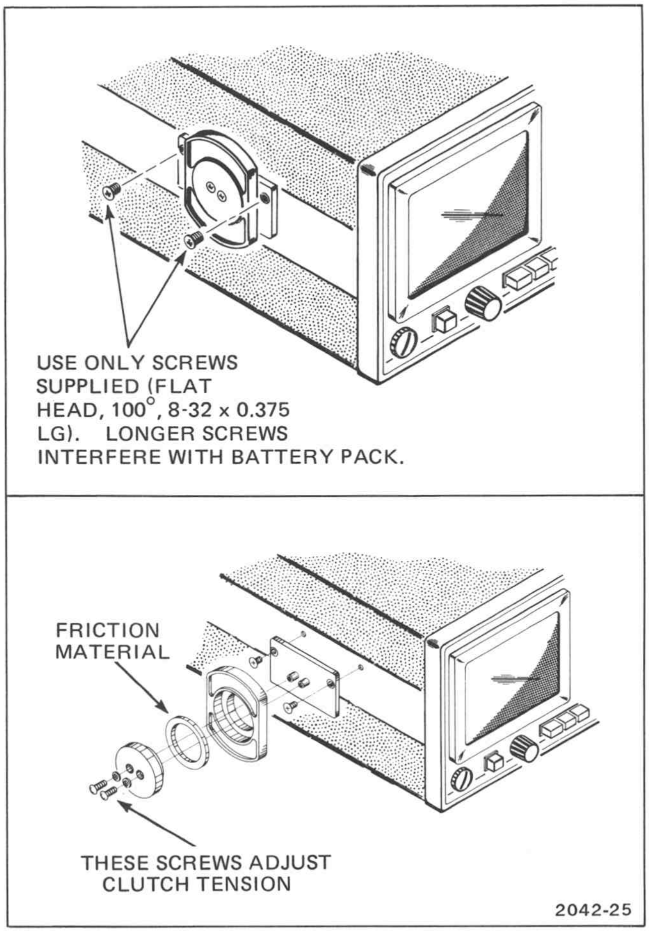


Fig. 1-3. Installing mounting adapter to monitor.

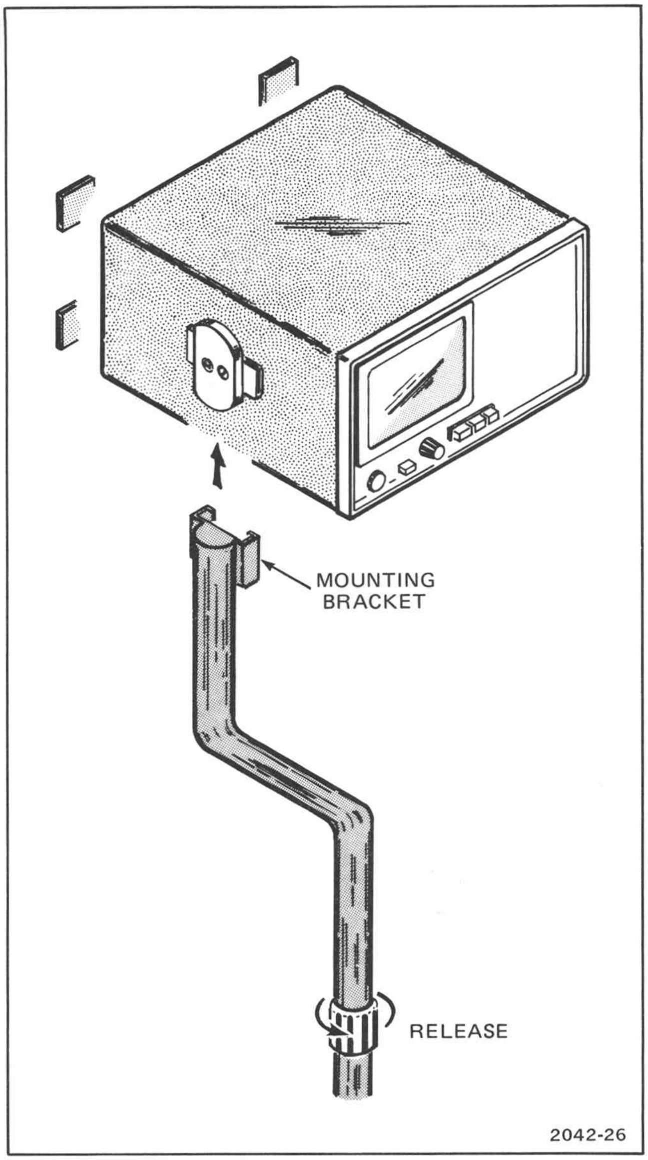


Fig. 1-4. Mounting monitor to mounting stand.

ATTACHMENT CABLE DIAGRAMS

Figures 1-5 through 1-8 are hook-up diagrams of the various cables and devices associated with the 414 input and output connectors.

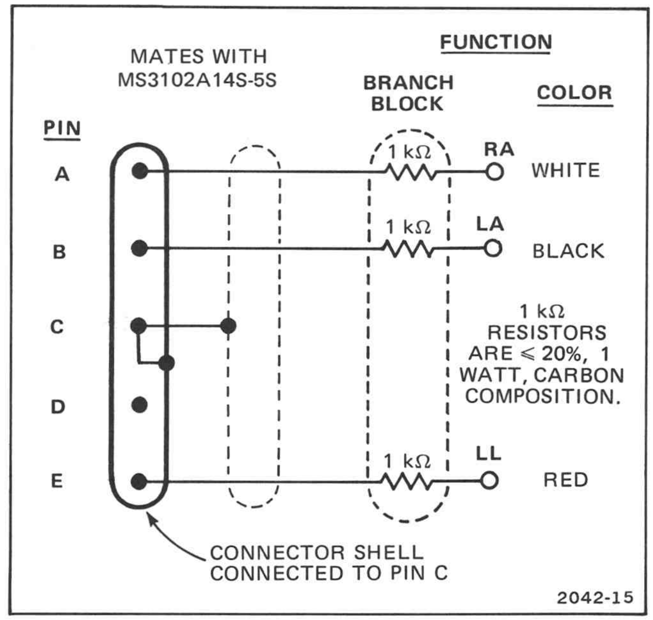


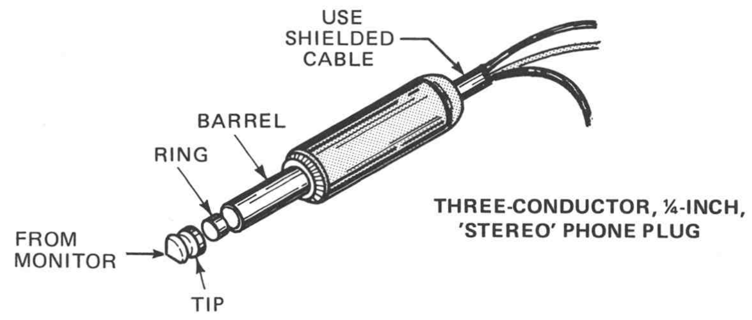
Fig. 1-5. ECG torso cable.

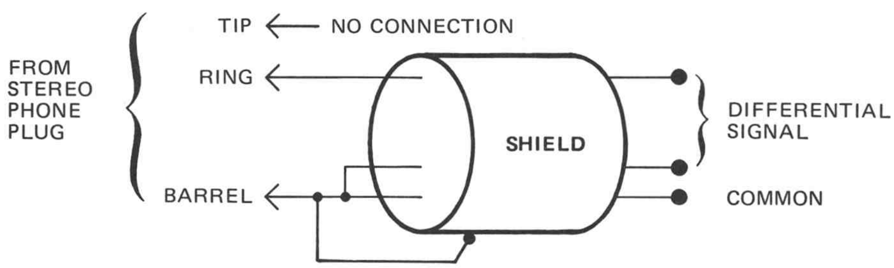
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LOW LEVEL

Provides a low-level (X1) output signal from the monitor's ECG or PRESSURE/PULSE channel.

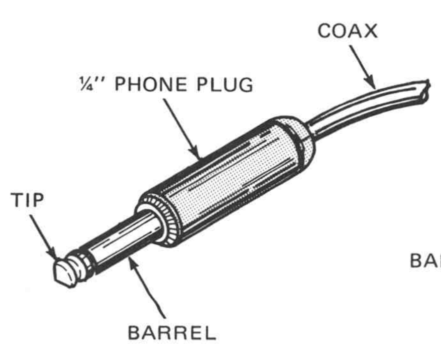
A three-conductor ¼-inch 'stereo' phone plug connects to the monitor.

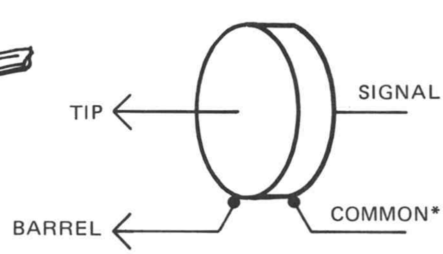




SHIELD CONNECTED ONLY AT PHONE PLUG END.

HIGH LEVEL





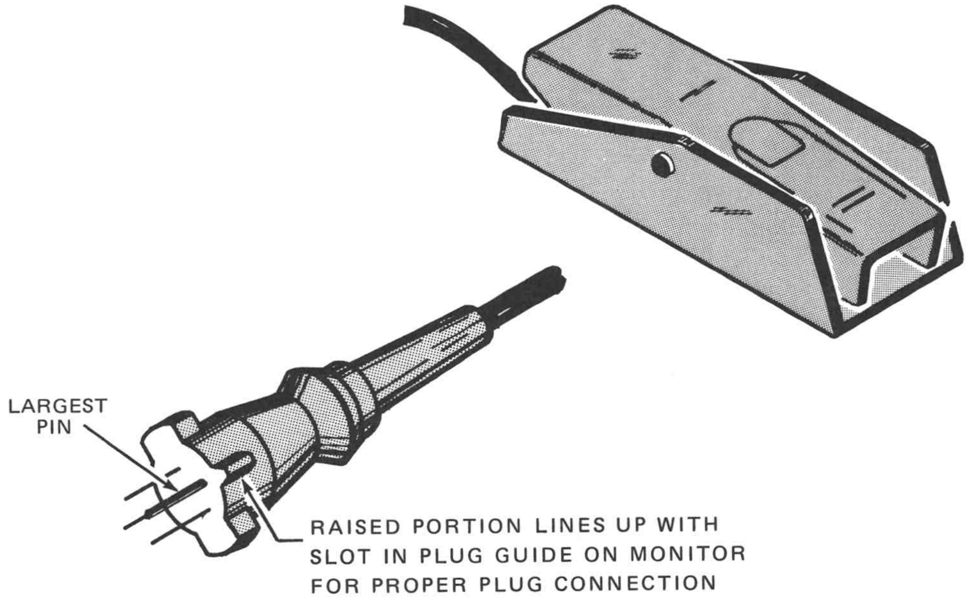
NOTE

A TWO-CONTACT PHONE PLUG WILL SHORT TO GROUND THE LOW-LEVEL OUTPUT SIGNAL. THIS WILL NOT ADVERSELY AFFECT MONITOR PERFORMANCE.

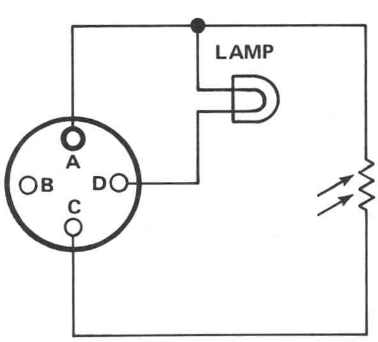
*COMMON SHOULD NOT BE GROUNDED BY THE DEVICE RECEIVING THE SIGNAL. SINGLE-ENDED FLOATING OR FULL DIFFERENTIAL INPUTS ON THE RECEIVING DEVICE WILL PREVENT GROUND-LOOP CURRENTS.

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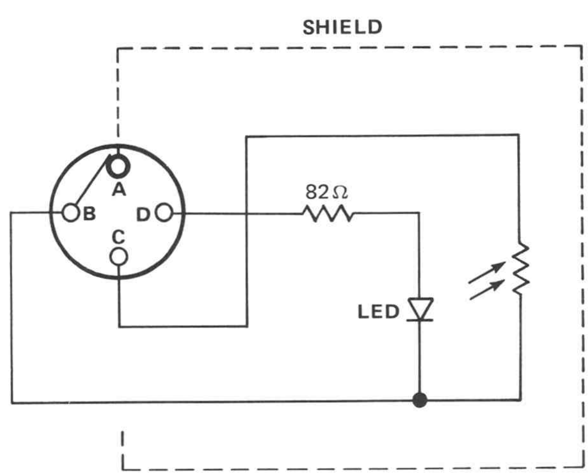
Fig. 1-6. Output cables.



A plug similar to Winchester M4PLSH10C on the pulse sensor cable mates with the Winchester M4SLRN bulkhead connector on the monitor.



Typical incandescent lamp draws 40 mA at 3.6 V.



Typical light-emitting diode (LED) with series resistor draws 22 mA at 3.6 V.

2042-17

Fig. 1-7. Pulse sensor.

Plug number MS3106A-14S-6P on the pressure transducer cable mates with the MS3102A-14S-6S bulkhead connector on the monitor. The cable clamp number is MS3057-6A and the bushing number is MS3420-6.

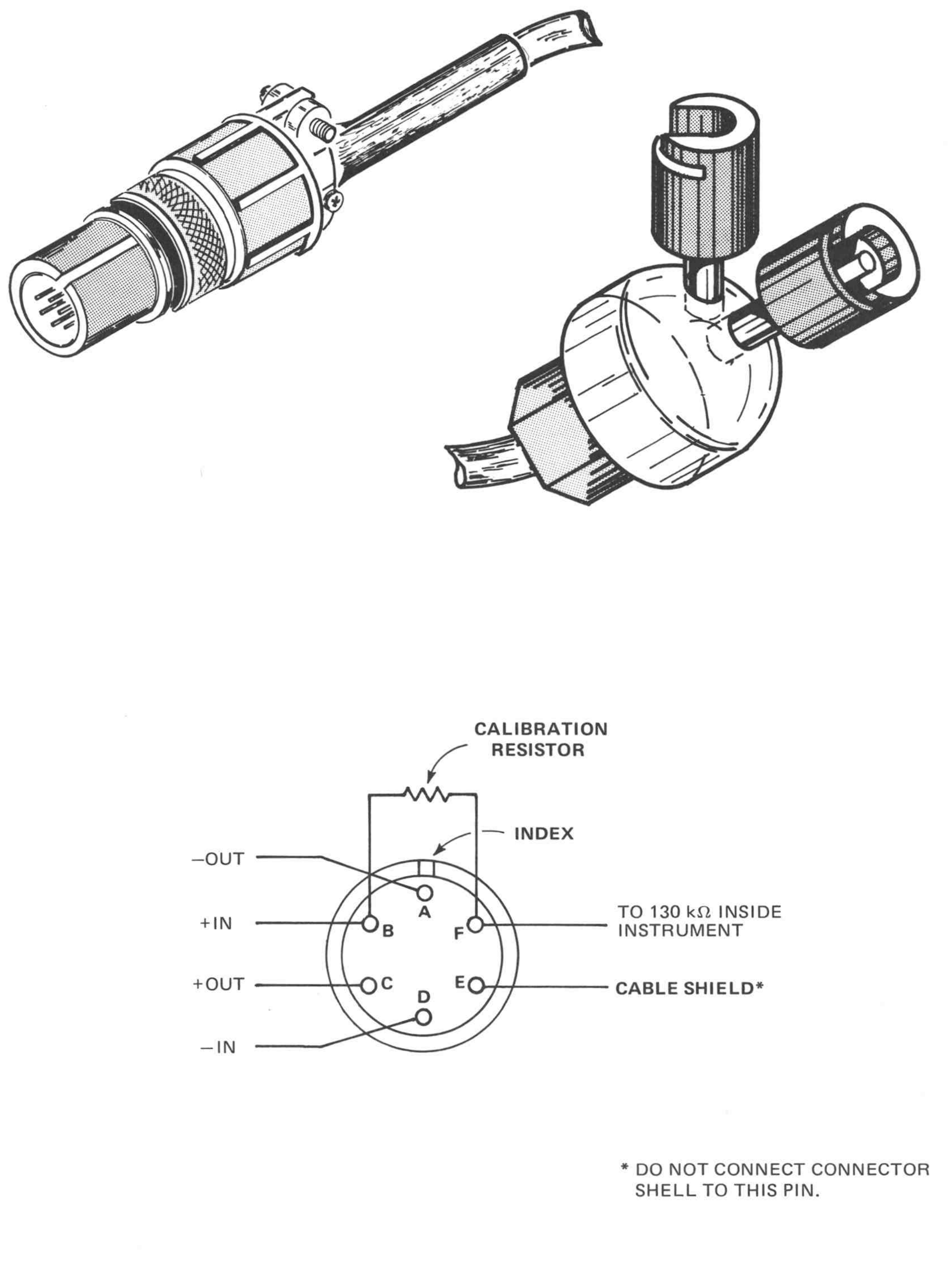


Fig. 1-8. Pressure transducer.

OPERATING INFORMATION

INTRODUCTION

AC LINE OPERATION

This monitor is designed for safe ac power-line operation. Battery operation has been provided specifically for mobile monitoring (e.g., during movement of the patient from O.R. to recovery). The monitor will operate on an ac power-line regardless of battery pack installation or battery pack charge level.

The monitor is shipped from the factory with: (1) the LINE VOLTAGE RANGE switch set at 115, (2) the correct fuse installed for 115 volt operation and (3) the correct "Hospital Grade" line cord cap (plug) for operation in the U.S.A. on 115 volt ac-power lines.

To change nominal power-line voltage, move LINE VOLTAGE RANGE switch (Fig. 2-1) using small-bladed screwdriver. Change the line fuse to the correct value as indicated on the rear panel. Change the line-cord plug to the type approved for the location where the monitor is to be used.

CAUTION

This monitor may be damaged if connected to a 230 volt source with the LINE VOLTAGE RANGE switch set at 115.

AC Power Source

The 414 is compatible with isolated power systems such as used in operating rooms.

MONITOR OPERATION WITH NON-ISOLATED POWER SYSTEMS. The monitor is intended to be operated from a single-phase earth-referenced power source having one current-carrying conductor (the neutral conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-phase system) is not recommended, since only one conductor has fuse protection within the monitor.

AC Power Cord and Plug

The monitor has a three-wire power cord with a three-terminal polarized 'Hospital Grade' plug for connection to the power source and safety earth. The ground (earth) terminal of the plug is directly connected to the monitor frame. For electrical shock protection, insert this plug only in a mating outlet with a safety-earth contact which is marked 'Hospital Grade'.

Inspect the power cord periodically for fraying or other damage, and repair as needed. Do not operate the apparatus from ac power with a damaged power cord or plug.

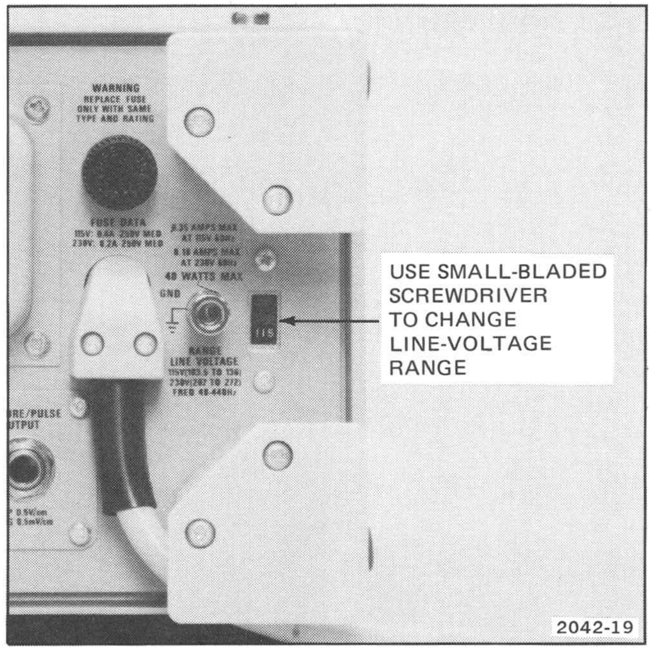


Fig. 2-1. LINE VOLTAGE RANGE switch.

BATTERY OPERATION

Disconnecting the monitor from the ac line with the POWER switch pushed in (on) will automatically start battery operation. A new correctly charged D-cell battery pack typically provides 1.7 hours of operating time (2.7 hours from an F-cell battery pack). The operating time varies with the functions used.

Battery Condition

The BATTERY meter on the front panel indicates battery condition as shown on the next page.

(A). POWER OFF OR DISCHARGED. Battery is charging if the monitor is plugged into an ac outlet. If the ac power-line plug is not plugged in and the POWER button is in (on), the battery is discharged. Plug the ac-line plug into an ac outlet to operate the monitor and charge the batteries.

(B). CHARGED. POWER button is in (on). If the ac power-line plug is connected to an ac outlet, this is a correct indication, but does not show battery condition. A battery peculiarity may cause the meter to read high during the first fifteen minutes of operation following disconnection from an ac outlet—this may be a false indication of a charged battery.

(C). PARTIAL CHARGE. POWER button is in (on). A few minutes of operating time remains.

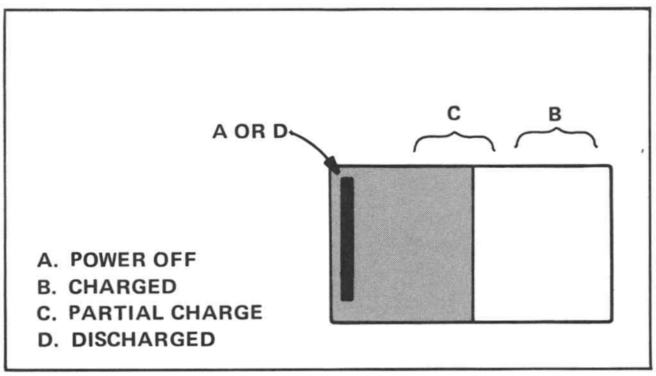


Fig. 2-2. Battery condition.

Battery Charging

Connect ac power-line plug in to the appropriate ac source to charge batteries.

Battery characteristics require that charging be done in a temperature range between 0° and +25° C for maximum charge. The greater the temperature above +25° C, the less charge the battery will accept. Battery operation is reduced 50% or more if charging is done in a +50° C environment. Longer charging time will not compensate for a high temperature.

OPERATING TEMPERATURES

CAUTION

The reliability and operating life of the digital display devices may be significantly and permanently reduced if they are operated below 0° (+32° F) for more than a few minutes. When the instrument is operating, infrequent ambient temperature excursions slightly below 0° C can be tolerated. This is due to inherent self-heating from the instrument and the device itself.

The monitor will operate and meet all specifications over a range of 0° to +50° C.

The monitor will function, but not necessarily meet its specifications over the extended range of −15° to +55° C. See caution above.

The monitor may be stored in an environmental temperature range of −40° to +60° C.

A cool monitor taken into a warm, humid environment may cause condensation within the case. This condensation may create discharge paths on the circuit boards. The monitor should be allowed to dry thoroughly before using. The appearance of condensation on the monitor case is a good indication that moisture may have been drawn into the case.

FUNCTIONS OF CONTROLS, CONNECTORS AND INDICATORS

FRONT PANEL

(1) **BATTERY.** The meter indicates the approximate state of charge of the battery pack when the monitor is in battery operation (POWER button in (on) and ac power-line plug not connected to an ac power source). To interpret the meter reading, see Fig. 2-2.

(2) **POWER.** This button turns the monitor on or off. The battery charger operates continuously as long as the monitor is connected to an ac power source.

(3) **BEAT LOUDNESS.** This control adjusts the loudness of the beat tone and should be set fully clockwise if maximum loudness is desired. The beat tone is heard once for each QRS pulse during ECG use, or once for each rising portion of the pressure or pulse waveform during pressure or pulse operation.

(4) **SWEEP SPEED mm/SEC.** Three buttons select the speed of the trace across the screen. The sweep speeds are 25, 50 or 100 mm/SEC. The total time it takes the trace to cross the screen is 4, 2, or 1 seconds, respectively. The sweep is triggered when either 50 mm/SEC or 100 mm/SEC is selected and non-triggered when 25 mm/SEC is selected.

(5) **ZERO.** Adjustable with finger tip or screwdriver. It permits establishment of a zero-pressure reference. Pressing the knob in while rotating provides fast, accurate indication on the digital display.

(6) **100 mm CHECK.** Usable only with standardized pressure transducers which contain a factory standardized calibration resistor. With such a transducer connected to the monitor, this button provides a 100 mm test signal display each time it is pressed.

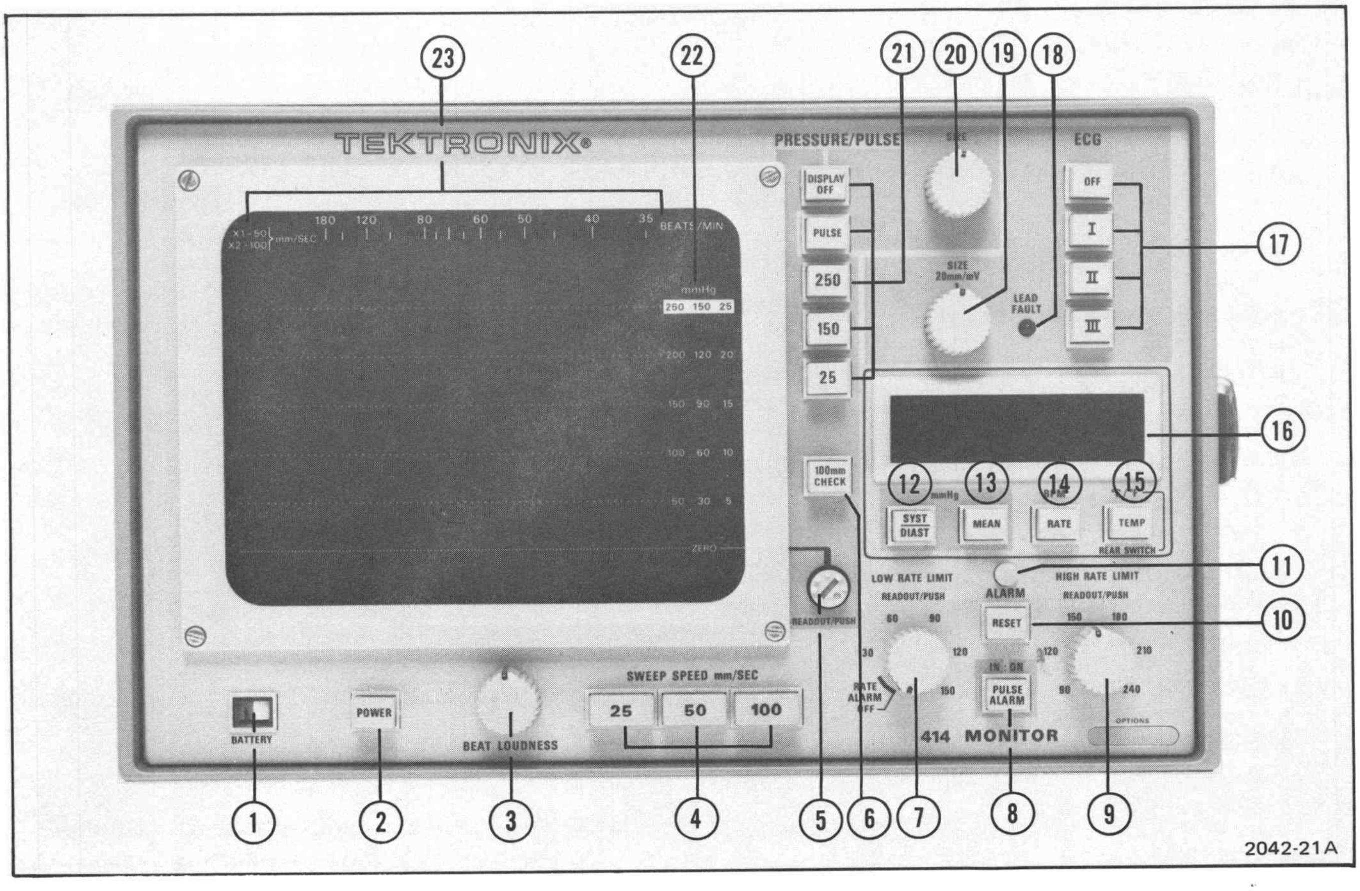


Fig. 2-3. Front panel controls and indicators.

There is no display change when a transducer without a calibration resistor is used. A reading between 95 and 105 mm is expected on the digital meter when pressing this button and the ZERO control simultaneously—the digital display indicates over range when 25 mmHg is selected. Be careful not to disturb the ZERO setting while pressing the ZERO knob.

(7) **LOW RATE LIMIT.** This control turns the rate alarm on and sets the lower rate alarm limit between 30 and 150 beats per minute. For a more accurate setting, press the control in while adjusting it, and set the desired value on the digital display. Rotating this control to the RATE ALARM OFF position (fully ccw), turns the alarm off and also resets it.

(8) **PULSE ALARM.** Activates the alarm if the average pulsatile pressure (systolic minus diastolic) remains below 10 to 15 mmHg for approximately 10 seconds, or if the pulse signal amplitude remains below 0.3 to 0.5 cm of display for approximately 10 seconds. For pressure, this can indicate a broken, plugged, or dislodged catheter. For pulse, it can indicate a loss of peripheral circulation (e.g., in great toe during catheterization of femural artery). Alarm is inhibited when switch is in the out position.

(9) **HIGH RATE LIMIT.** This control sets the upper rate alarm limit between 90 and 240 beats per minute. For more accurate setting, press control while adjusting and set desired value on digital display.

(10) **RESET.** This button resets the alarm. If the condition which caused the alarm still exists, the alarm will occur again shortly after the button is released. If the alarm was the result of an acceptable change in patient condition, then new limits must be selected and the RESET button must be pushed again. However, if the alarm was the result of an unacceptable change, the LOW RATE LIMIT control should be set to ALARM OFF to prevent reoccurrence of the alarm.

(11) **ALARM Light.** Lights whenever an alarm condition occurs.

(12) **SYST/DIAST.** Display alternates between systolic and diastolic readings expressed in millimeters of mercury (mmHg). Complete readout cycle takes about 3 seconds. DISPLAY OFF button can be in or out.

(13) **MEAN.** Displays arithmetic mean of pressure signal in mmHg. DISPLAY OFF button can be in or out.

(14) **RATE.** Displays heart rate in beats per minute. Source is ECG when ECG is on. When ECG is off, either pressure or pulse provides the rate information.

(15) **TEMP.** Displays temperature in °C or °F as selected by the rear panel switch. Resolution is 0.1°. Use only the dual-thermistor Yellow Springs Instrument Co. 700 Series Probes.

(16) **Digital Display.** Provides digital display of pressure, (mmHg), rate (beats/min), temperature (°F/°C), rate alarm limits setting, or zero pressure setting. Polarity is indicated automatically to aid in setting of transducer zero and for reading vacuum. Readout display flashes to indicate over range and is blanked if combination of functions selected is invalid.

(17) **ECG.** Selects one of three ECG lead configurations or channel off. The four buttons control the display on the upper half of the screen (if the PRESSURE DISPLAY OFF is pressed in, the ECG display will move to the screen center). The DISPLAY OFF button turns off the ECG display and centers the pulse display (if present) on the screen. A pressure display will remain referenced to the ZERO line.

(18) **LEAD FAULT.** This light-emitting diode lights to indicate the following lead fault problems:

a. An open circuit (break) in the patient cable or in the electrode wires or electrodes.

b. Insufficient gel or paste on the electrode(s).

c. One or more electrode attachment wires disconnected.

d. All ECG buttons out.

e. Two or more ECG buttons pushed in.

f. Excessive dc offset in one or more electrodes.

(19) **ECG SIZE.** This control varies the height of the ECG display. The ECG OUTPUT signal is not affected by the SIZE control.

(20) **PULSE SIZE.** This control varies the height of the pulse display when the pulse mode of operation is being used. The PRESSURE/PULSE OUTPUT signal varies as the display signal varies during the pulse mode of operation. Small signals (one-half division or less) may not cause a beat tone when the ECG channel is off and the pulse channel is providing the beat information. Display amplitudes that go off the screen may cause extra beats to be heard. Adjust the SIZE control for a two to three centimeter display where possible.

(21) **PRESSURE/PULSE.** Five buttons control display of the pressure or pulse signal. When any one of the three pressure ranges (250, 125, or 25) is selected, the zero pressure display is adjustable to the ZERO reference line. When the pulse mode is selected, the pulse display baseline is either positioned to screen center (ECG channel off) or 2 cm below screen center (ECG channel on). When the DISPLAY OFF button is pressed, the pressure or pulse display is removed from the screen and the remaining ECG display (if present) is centered on the screen. The pressure/pulse channel is always on, regardless of the position of the DISPLAY OFF button, and the values can be selected on the digital display.

Small signals (one-half division or less) may not cause a beat tone and the pulse alarm will be triggered. Display amplitudes that go off the screen may cause extra beats to be heard (when the ECG channel is off and the pressure channel is providing the beat information). Select the appropriate pressure range.

(22) **Pressure Scales.** These three scales correspond to the pressure range selected: 250, 150, or 25 (50 in Option 21 instruments). The vertical portion of the pressure signal is compared to the appropriate scale to determine pressure amplitude in mmHg.

(23) **BEATS/MIN Scale.** The display graticule (screen) is marked in beats per minute for use with the 50 mm/SEC sweep speed. To read beats per minute at 100 mm/SEC, multiply the BEATS/MIN reading by 2. The scale is not usable for 25 mm/SEC since the sweep is not triggered at that speed.

At certain heart rates, a spot will appear at the left-hand edge of the display. This is the starting point of the sweep, which has been reset and is waiting for the next triggering event. Any vertical movement of this spot is an accurate indication of the events prior to triggering.

SIDE PANEL

(24) **ECG LEAD CHECK Terminals.** These three terminals provide pulses which permit checking cable defects, electrode wire defects, amplifier operation and the QRS detector function. When the patient wires are connected to the ECG LEAD CHECK terminals, an ECG lead selector button is pushed in and the ECG SIZE control is at 20 mm/mV, the display should be:

Lead	Display
I	2 centimeters of positive-going signal
II	3 centimeters of positive-going signal
III	1 centimeter of positive-going signal

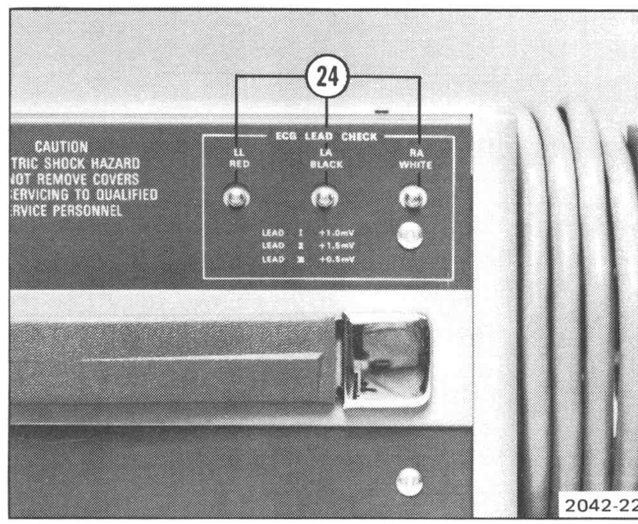


Fig. 2-4. ECG LEAD CHECK terminals.

REAR PANEL

(25) **ECG INPUT.** Provides a means for connecting ECG input signals to the monitor.

(26) **TEMPERATURE SENSOR INPUT.** Provides a means for connecting the Temperature Sensor signals to the monitor.

(27) **° F/° C.** Switch selects temperature scale for the digital display.

(28) **ALARM LOUDNESS.** Adjusts the loudness of the alarm signal. Set fully clockwise if maximum loudness is desired.

(29) **PRESSURE TRANSDUCER INPUT.** Provides a means for connecting Pressure Transducer signals to the monitor.

(30) **PULSE SENSOR INPUT.** Provides a means for connecting Pulse Sensor signals to the monitor.

(31) **ECG OUTPUT.** Provides two ECG signal output levels through a stereo phone plug. The output signal at the TIP contact represents the ECG input signal X1000 within a linear range of ± 2.5 V.

The output signal at the RING contact represents the ECG input signal X1 within a linear range of ± 2.5 mV; 10 mV maximum during over-drive. The RING output is useful for direct recording on a standard ECG machine or slaving one monitor to another.

(32) **ALARM.** Provides for remote indication and resetting of alarms through a stereo phone plug. Shorting the TIP contact to the barrel (ground) causes the alarm to be reset. This allows the alarm to be reset either with the front panel RESET button or with a remotely located switch. The RING contact provides a signal for a remote alarm indicator, a light, or other indicator. The output current for the alarm is 12 mA, and the voltage is limited to about + 5.5 V. The barrel contact is the current return path for this output. This current output is suitable for driving solid-state relays having light-emitting-diode inputs.

(33) **PRESSURE/PULSE OUTPUT.** This output connector provides two output levels from the pressure/pulse channel.

The TIP contact provides 0 to + 2.5 V within 5% of full scale (5 cm display) for pressure; 0 to −2.5 V for vacuum.

The RING contact provides 0 to + 2.5 mV within 5% of full scale for pressure; 0 to −2.5 mV for vacuum.

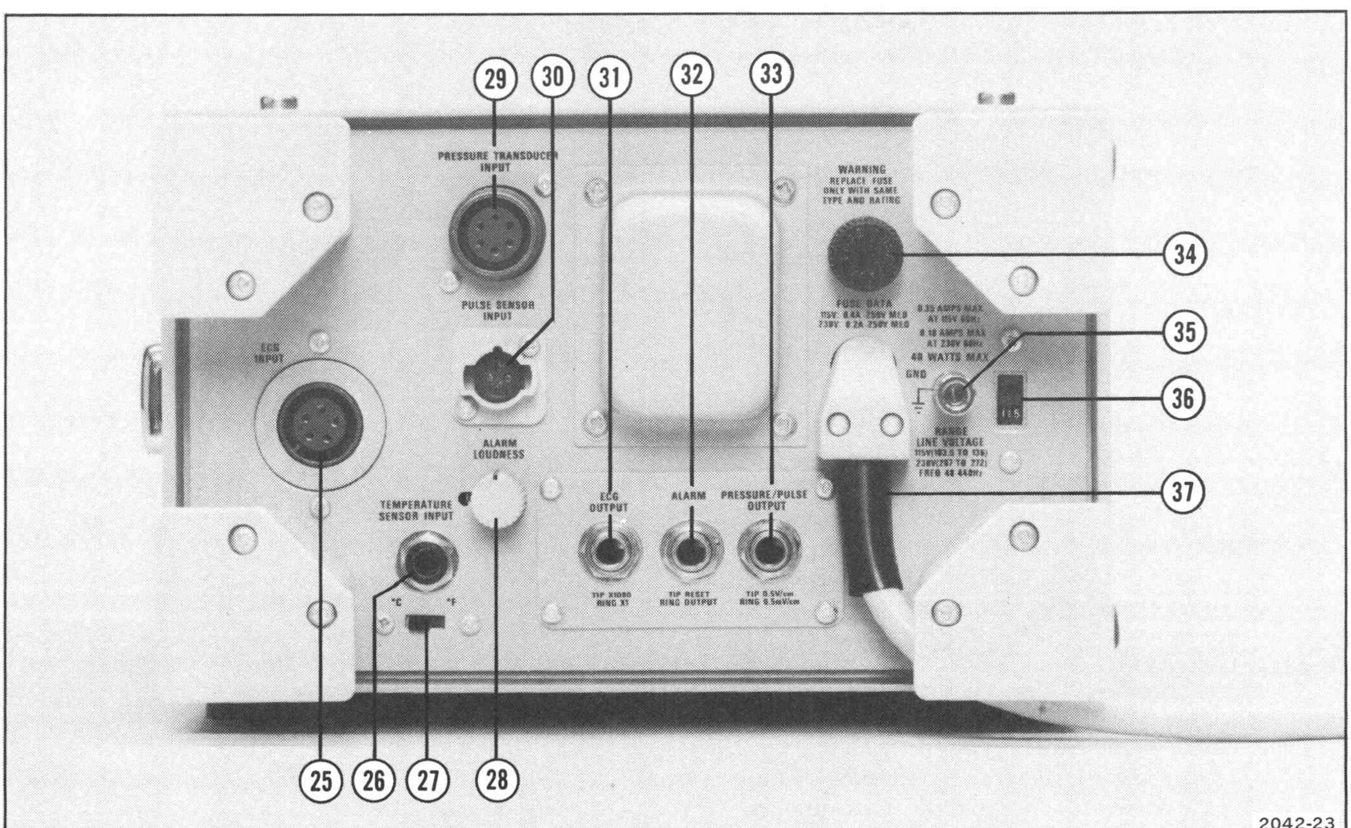


Fig. 2-5. Rear panel controls and connectors.

Vacuum signals displayed on the monitor will be limited by the bottom edge of the screen.

For pulse, the TIP contact provides −2.5 to +2.5 V (approximately 0.5 V per displayed centimeter) and the RING contact −2.5 to +2.5 mV.

NOTE

Shorting the output signal to monitor ground will not damage the monitor. Should a RING contact be shorted to ground (e.g., by a non-stereo plug), the TIP outputs and the display will not be affected. Should the ECG OUTPUT TIP contact be shorted, the display will be affected but not the beat or alarm. Should the PRESSURE/PULSE OUTPUT TIP contact be shorted, the display, beat, and alarm will be affected. If the ALARM TIP contact is shorted to ground, the alarm can not be triggered.

(34) **Fuse Holder.** Contains the ac power-line fuse.

(35) **GND.** Provides an additional grounding point (there is one in the power plug) for the instrument case. When the power plug is not connected to a power source, the case may be grounded as added protection against any voltage source (that might contact the case) from reaching the patient. Grounding through the power cord requires an appropriate three-wire outlet. Do not use a three-terminal to two-terminal adapter.

(36) **Line-Voltage Selector.** This switch is a screwdriver-operated slide switch. It should indicate the correct nominal ac line voltage.

(37) **AC Line Cord and Plug.** Permits connection to the line for ac operation and battery charging.

THEORY OF OPERATION

The circuitry in the 414 Monitor is largely contained on eight circuit boards (see Fig. 3-1). The Main (largest) Board contains the Trace Chop Multi, the Vertical Amplifier, Sweep Trigger, Sweep Generator, Horizontal Amplifier, Audio Amplifier, Power Supplies, CRT circuitry, and Battery Charger. The Main Board is mounted horizontally on the lower part of the monitor.

Four other boards (DVM, Pressure/Pulse, Readout Conditioner, and ECG) plug into sockets mounted on the Main Board. These boards are mounted directly behind the front-panel controls.

Three small boards (Readout Selector, Display, and Alarm) are mounted on the front panel.

Ribbon cables with multi-pin connectors interconnect the circuit boards and other components.

The QRS beat and alarm speaker is mounted inside the left-side frame, near the front of the instrument.

The power transformer, with all other ac-line-voltage circuitry, is mounted to the rear panel.

A simplified block diagram for each major circuit board shows the basic circuit sections and signal flow. Each major circuit-board section is described in detail.

Detailed schematics of each circuit are located in the Diagrams section at the back of this manual. Refer to these schematics throughout the following circuit description for specific electrical values and relationships.

ECG BOARD ⟨1⟩ ⟨2⟩

ECG Amplifier Circuit Functions

The ECG circuit accomplishes the following:

1. Amplifies the ECG signal (three input lead configurations). The circuit provides extremely low-leakage isolation (less than 5 μA, rms at 120 Vac, 60 Hz) between patient and monitor. The input circuitry is protected for use during defibrillation and electrocautery.

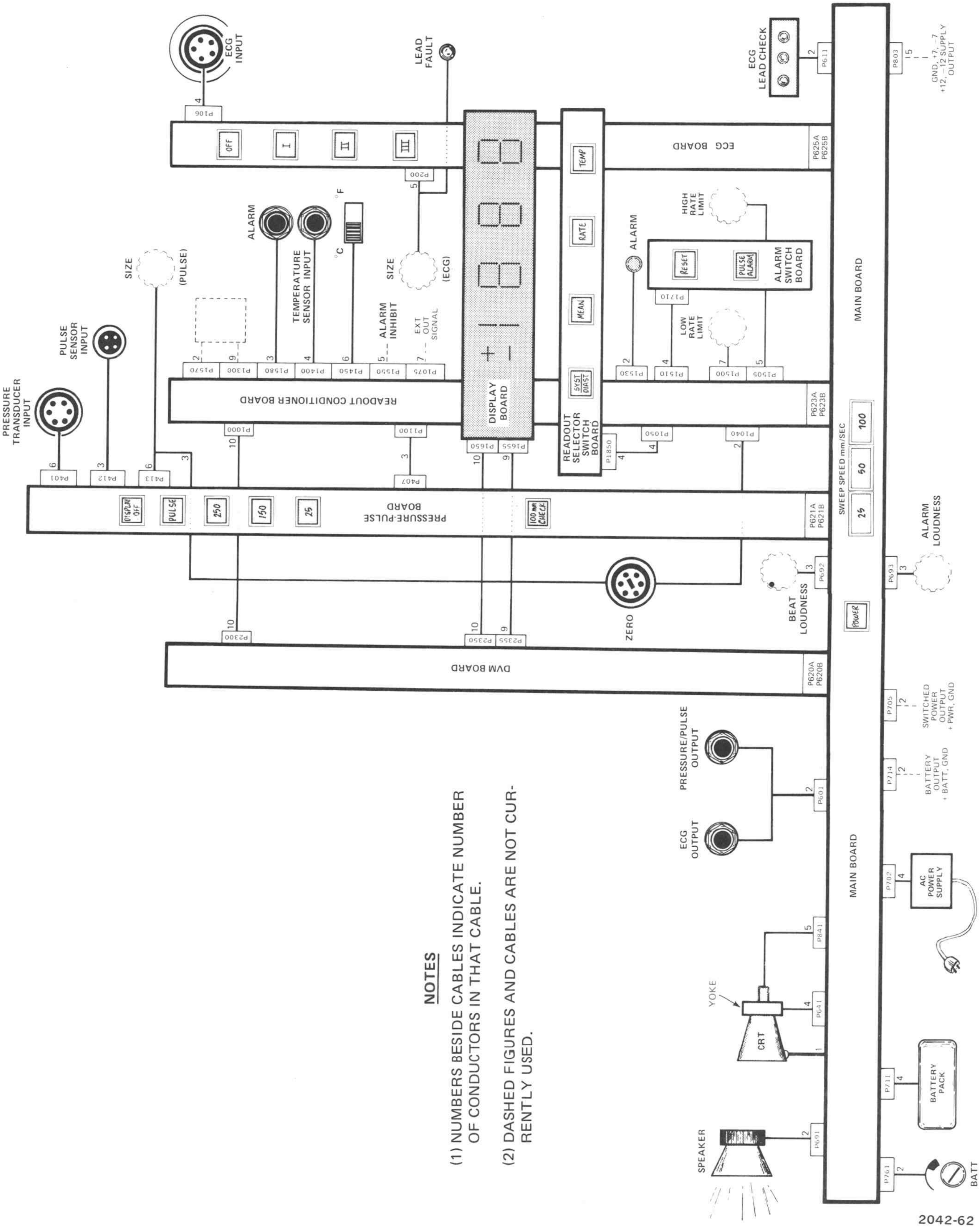
2. Indicates when a fault exists in ECG input cables, wires, electrodes, etc.

3. Provides ECG output signals to a rear-panel jack. Output amplitudes are fixed at X1000 and X1 of the input signal.

4. Provides an amplified ECG display signal, whose amplitude is variable with the SIZE control. When only the ECG channel is on (single trace), the display baseline is positioned to the screen center. When the pressure/pulse channel is also on (dual trace), the display baseline is positioned about 2 centimeter above the screen center. The positioning is determined by a logic signal from the pressure/pulse board.

5. Provides a logic signal to indicate whether the ECG channel is off or on. This signal goes to:

   a. The Main Board, to allow display of this channel either in single or dual trace, depending upon the status of the pressure/pulse channel.



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Fig. 3-1. Circuit boards and interconnections.

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b. The Main Board, to select the trigger source, either from the ECG channel (ECG on) or from the pressure/-pulse channel (ECG off).

c. The Pressure/Pulse Board, to set the pulse display baseline position at the screen center for pulse only or about 2 centimeters below screen center for dual trace (pulse and ECG).

6. Provides a QRS selected trigger to the Main Board for sweep triggering and beat tone and to the Alarm Switch Board for analysis of alarm conditions. The trigger circuit rejects pacer signals.

ECG Amplifier Circuit Operation

The ECG signal enters the input amplifier (Fig. 3-2) through three electrode wires. One of the wires is signal reference and the other two are used for a differential input signal. The ECG push buttons are used to select any pair of wires as the input signal.

The ECG patient cables contain a resistor in series with each input wire. These resistors and the input protection circuit protect the input amplifier during defibrillation and electrocautery.

A very small amount of current (1 nA) is injected into the patient electrodes. When this current is interrupted in any input wire, (such as when a wire breaks) the LEAD FAULT indicator lights.

The input amplifier is isolated from the other circuitry and from the monitor chassis. The shield covering the ECG input amplifier circuitry and the shield in the patient cable are connected to the floating ground point to reduce ac interference.

A floating power supply (250 kHz converter) provides the power for the Isolated Input Amplifier through transformer T155. The circuit is designed so that the amplified ECG signal varies the loading on the transformer, which causes the supply current to change. This changing current becomes an amplified voltage-signal at the output of the Current-To-Voltage Converter.

The output of the Current-To-Voltage Converter provides signals to the QRS Detector and the input signal to the AC-Coupled Amplifier.

The AC-Coupled Amplifier provides the remainder of the needed gain and determines the high and low-frequency response of the ECG channel. Gain and dc level are set by the two calibration adjustments in this circuit. Output of this amplifier provides the ECG output to the rear panel and the input to the Display Amplifier.

In the Display Amplifier, ECG-display-signal amplitude can be varied with the SIZE control. This control does not change the ECG-output signal amplitude to the rear panel. A logic signal from the Pressure/Pulse Board positions the ECG-display baseline for single or dual-trace operation.

FLOATING POWER SUPPLY. This circuit consists of a converter (Q156, Q158), a transformer (T155) and a rectifier-filter circuit. The converter produces an approximate 250 kHz trapezoidal wave. The frequency is dependent upon the load on the converter. T155 is insulated for at least 5 kV.

ISOLATED INPUT AMPLIFIER. Circuitry is provided that protects the input amplifier during electrocautery and defibrillation. Input voltage is limited by DS105, DS107, DS109, R107, R114, CR107, CR109, CR114, CR116, VR120, VR122 and the 1 kΩ resistors in the patient cable. Capacitors C105, C107, and C109 reduce rf interference from TV and radio signals and electrocauterizers. Resistors R107 and R114 also provide patient protection in case of circuit failure.

Resistors R104 and R112 supply about 1 nA to the patient electrodes. If this current is interrupted (wire breaking or high electrode resistance), the display will shift off screen and the LEAD FAULT indicator will light.

The input amplifier is a differential-input, single-ended-output circuit consisting of balanced pair Q110A and Q110B and output amplifier U120B. The output of U120B varies the current through R138 in proportion to the ECG-input signal. The differential gain of the amplifier is determined by feedback dividers R133/R136 and R117/-R130. The gain up to TP136 is about 23.6 times the input signal.

U120A maintains the junction of R130 and R133 at 0 volts (referenced to the floating ground), which permits R127 to set a constant current through Q110A and Q110B. U120A also provides negative feedback through the reference wire and the patient to Q110A and Q110B, which reduces the ac common-mode signals to a very low level.

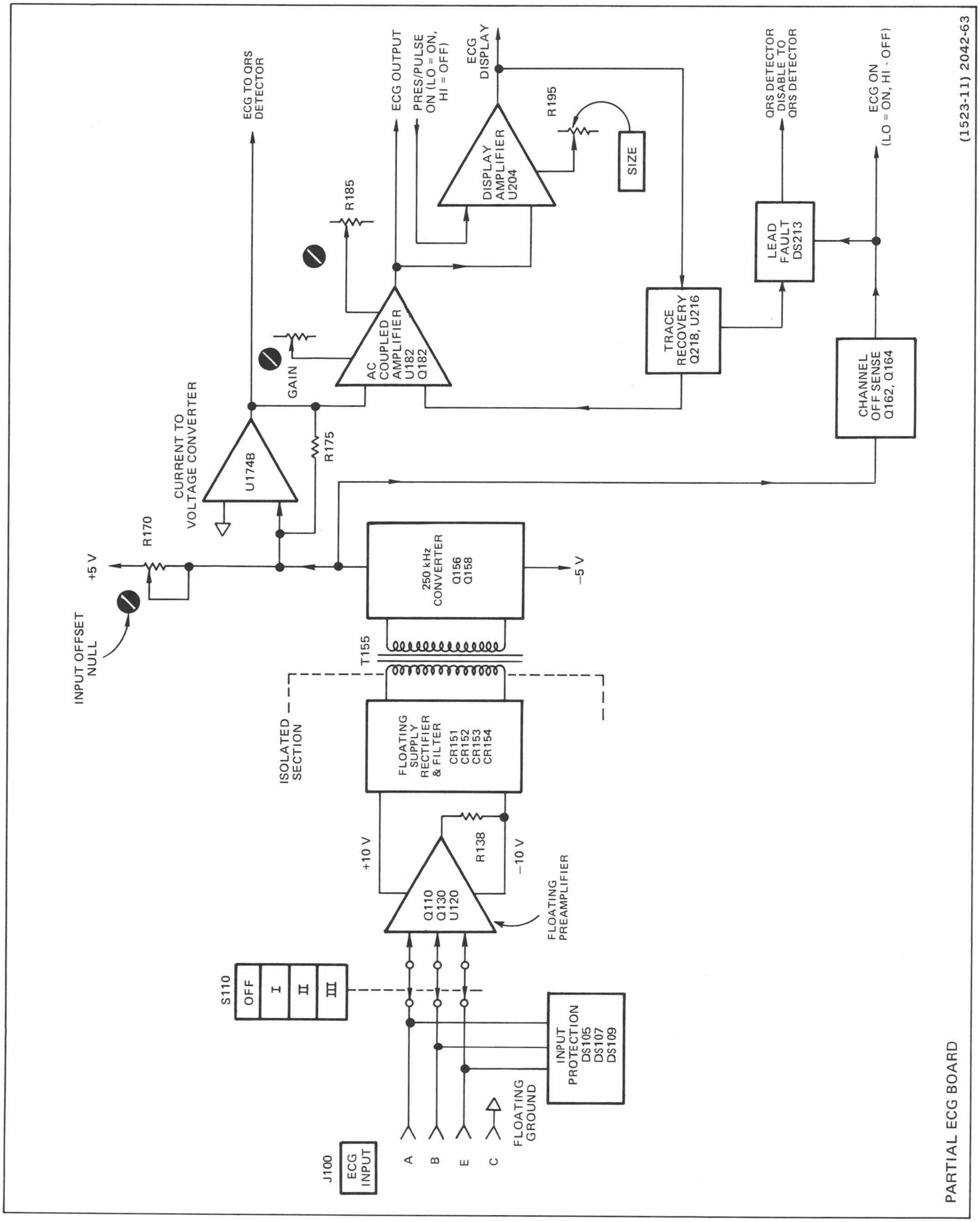


Fig. 3-2. ECG Amplifier block diagram.

When no signal is applied there should be about 0 volts at TP136 and at the junction of R130 and R133. Under this condition, R138 current is about 5 mA.

R138 current comes from the +10 V supply, through U120B and to the −10 V supply. When a signal enters the input amplifier, the current through R138 increases or decreases which changes the load on the 250 KHz Converter.

CURRENT TO VOLTAGE CONVERTER. Feedback action of U174B maintains 0 volts at TP170, by way of R175. R170, Input Offset Null is adjusted so that TP178 is 0 volts when no signal is applied to the ECG INPUT.

The ECG input signal thus varies the current in the 250 KHz Converter. Since the current through R170 and R172 is constant, the current through R175 will change. The changing current in R175 is produced by a voltage at the output of U174B which is 50 times the ECG input signal. The gain is determined by the Isolated Input Amplifier gain up to TP136, the turns ratio of T155 and the ratio of R175 to R138.

R178 and C178 filter most of the inverter hash from the signal. Remaining hash is removed by the AC-Coupled Amplifier.

AC COUPLED AMPLIFIER. U182 and its associated circuitry make up a special form of non-inverting amplifier with upper and lower bandwidth limits.

Short-duration overdrive signals will not shift the display baseline significantly because ac-coupling capacitor C181 is in the feedback circuit. The matched field-effect-transistors Q182A and Q182B are connected as a source follower and raise the load impedance to the ac-coupling network, R219-C181.

The X20 amplifier gain is determined by R179, R181, R183, R184 (Gain) and R186. High-frequency bandwidth is determined by R179, R181 and C179.[1] Low-frequency bandwidth is determined by C181 and R219.[1]

Resistors R179 and R181 limit the input dynamic range of the amplifier to ±7.5 V, corresponding to a ±150 mV dc offset at the ECG INPUT connector. This allows the LEAD FAULT indicator to be on when the input dc offset exceeds the ±150 mV limit.

DISPLAY AMPLIFIER. The times 1000 ECG signal from pin 1 of U182A goes to the Display Amplifier, which consists of U204A and U204B. U204B is an inverting operational amplifier with R193, R195 and R196 making up the gain-determining divider. The SIZE control R195, varies the gain approximately from X-1/3 to X3 with X1 gain at R195 mechanical center.

U204A is an inverting operational amplifier with a gain of 1/2. R199 and R200 set the dc level of the ECG signal depending upon the status of the pressure/pulse channel as detected at the cathode of CR200.

TRACE RECOVERY CIRCUIT. The Trace Recovery circuit speeds up the return of an off-screen signal. When the dc level at pin 1 of U204A exceeds ±1.0 V (corresponding to ±4 cm on the screen), Q218 conducts, shunting R217 across R219 to speed up the charging of C181 in the AC-Coupled Amplifier.

U216A, CR208 and CR205 act as a full-wave rectifier so that Q218 will turn on regardless of the polarity at pin 1 of U204A.

Capacitor C212 delays Q218 turn-on so that short-duration overdrive signals (such as pacer signals) will not affect the Q218 and lead-fault circuits. C212 also delays Q218 turn-off to allow the recovery action to return trace to its quiescent level.

LEAD FAULT CIRCUIT. When the ECG input dc offset exceeds about ±150 mV, the LEAD FAULT light-emitting diode, DS213, lights. The current, through DS213, is limited to 10 mA by CR215, CR216 and R215 and feedback action of U216B. When the ECG channel is off, a positive signal through CR213 keeps DS213 turned off. A signal from CR216 anode disables the QRS detector when DS213 is on.

CHANNEL OFF SENSE. This circuit consists of Q162 and Q164 which provides a logic signal to indicate whether the ECG channel is on or off.

When the ECG channel is off, the voltage at the base of Q162 is positive, which produces a 7 volt HI signal at the

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[1] **For diagnostic bandwidth of 0.5 Hz to 100 Hz, C179 and R21 can be changed to .022 μF and 2.2 MΩ.**

collector of Q164. This HI (off) signal keeps the LEAD FAULT light off and also goes to the pressure/pulse and the main boards to establish single trace conditions (when the pressure/pulse channel is on).

+5 V AND –5 V POWER SUPPLY. These regulated supplies provide power to the 250 KHz Converter and Input Offset circuitry. The +5 V regulating circuit, Q232, Q234 and VR235, is referenced to the –12 V supply. The –5 V regulating circuit is then referenced to the regulated +5 V supply.

QRS Detector Circuit Operation

The QRS detector (Fig. 3-3) evaluates the content of the incoming ECG signal to determine when the QRS portion occurs.

The QRS complex, or R-wave has at least one slope which has a greater rate of voltage change for a longer period of time than other portions of the ECG waveform.

When a QRS pulse is detected, an output signal is generated that triggers the sweep and rate beat tone, and supplies rate information to the rate limit alarm circuits.

The ECG signal passes through the automatic gain-controlled amplifier U324A, a differentiator circuit and a full-wave rectifier. The resulting positive signal contains one or more large, relatively wide, essentially sinusoidal pulses for each QRS complex at the input. Feedback through the automatic gain control circuit maintains pulse amplitude at about 3-4 volts.

Those portions of the pulses over 1 volt pass through the Amplitude Comparator to the Slope and Inhibit Timers. The first pulse greater than 6 ms wide that enters the slope timer circuit, will set the inhibit timer, which is the ECG trigger. The inhibit timer locks out any other pulses (i.e., pulses caused by T-waves) which may occur in less than 150 ms after the first pulse.

The pacer circuit eliminates pacer signals from the trigger signal. A signal from the LEAD FAULT circuit also prevents trigger output when the LEAD FAULT indicator is on.

AUTOMATIC GAIN CONTROLLED AMPLIFIER. U324 is a non-inverting amplifier with ac-coupled feedback (through C324 and C325), that provides a low-frequency cutoff of about 1 Hz. The gain of the amplifier is automatically controlled by feedback to a light-dependent resistor (LDR) CR324 from the +3 V comparator.

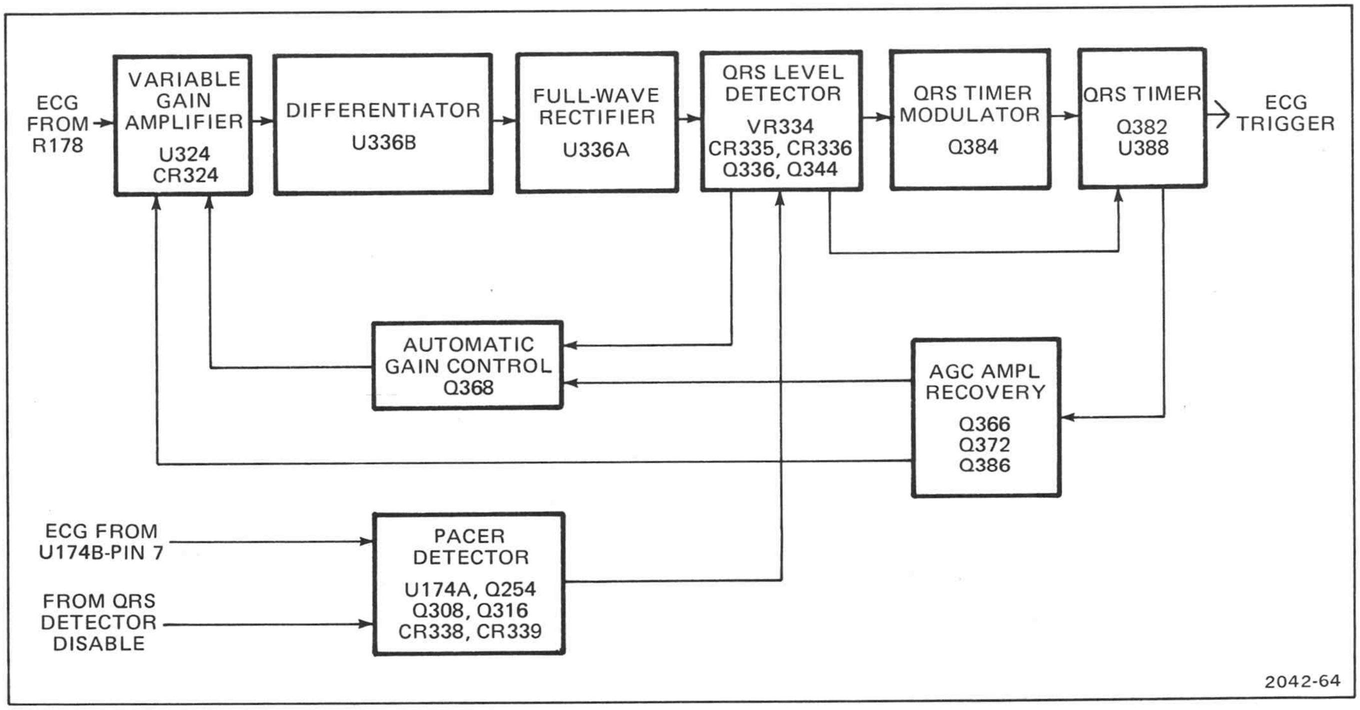


Fig. 3-3. QRS Detector block diagram.

DIFFERENTIATOR AND FULL-WAVE RECTIFIER. Signals from the automatic gain controlled amplifier are differentiated and inverted through U336B. The differentiated signal is then full-wave rectified, through CR332, for the rising portion, and through U336A (X1 inverting amplifier) and CR333 for the falling portion. This full-wave rectifier action produces two positive pulses for each positive or negative pulse into U324A, one pulse for the rising portion and the other for the falling portion.

AUTOMATIC GAIN CONTROL. The amplitude of the pulses at TP333 is controlled by feedback through Q336 and Q368 to CR324 in the U324 circuit.

The base of Q336 is set at about +3 volts by R336 and R337. Diode CR335 is normally conducting which keeps Q336 off. If the pulse amplitude reaches +3 volts, Q336 turns on, causing C367 to charge positive. This increases Q368 conduction, which increases the intensity of the LED in CR324 and reduces the gain of U324.

SLOPE AND INHIBIT TIMERS. When Q344 turns on, it biases Q382 off. When Q382 is biased off, C382 starts charging toward −7 volts. After about 6 milliseconds (depending on the action of Q384 and associated circuitry), the charge on C382 reaches the lower threshold (TL) point of U388, a one-shot, and it switches. The ECG Trigger output on U388 pin 3, goes HI for 150 milliseconds.

When U388 is switched, C388 is permitted to charge toward +7 volts. As the charge on C388 increases, the upper threshold (TH) of U388 is reached, it resets, and the ECG trigger signal goes LO.

Transistor Q384 provides noise immunity for the ECG Trigger circuitry. If considerable 60 hertz or other noise is present, the slope timer period set by Q382 and associated circuitry is automatically lengthened to a maximum of 10 milliseconds to prevent U388 from triggering on the noise. If the noise level is low, the slope timer period remains at 6 milliseconds.

AUTOMATIC GAIN CONTROLLED AMPLIFIER RECOVERY. If a QRS signal is not present for several seconds, pin 3 of U388 remains LO and cuts off Q386 long enough for C373 to charge and turn on Q372. This turns off Q366. With Q372 on, the dc-level recovery time is shortened by allowing C324 and C325 to charge more rapidly.

When Q366 is turned off, the AGC feedback time constant (R338, C367) is decreased by a factor of about 10 (R366 paralleled with R338) so that the gain will rapidly increase to compensate for a weak QRS signal. In the absence of a signal the gain increases to maximum and remains until the signal returns. At that time, VR334 will conduct through R334 to rapidly reduce the gain within range of the normal feedback control.

PACER DETECTOR. The Pacer Detector keeps pacer signals from entering the Q336 gain control and the Q344 amplitude comparator circuits. U174A is a differentiator with limited upper bandwidth. A pacer pulse at the input to C303 produces an output at pin 1 of U174A. When the pulse at pin 1 of U174A exceeds + or −5 volts, a negative output at the collector of Q254 triggers Q308 into conduction. This action discharges C315 in the positive direction, which causes Q316 to saturate and pull the cathodes of CR338 and CR339 below +1 volt. This clamps the Q336 and Q344 emitters below +1 volt to lock out signals to the timing and feedback circuits for the duration of the pacer detector output pulse (about 20-30 milliseconds).

PRESSURE/PULSE BOARD ⟨3⟩

Circuit Functions

The Pressure/Pulse circuit (Fig. 3-4) accomplishes the following:

1. Provides excitation power to the transducer or pulse sensor.

2. Amplifies the pressure transducer or pulse sensor output signals. In the pressure mode, three amplification ranges are provided: 25 mmHg, 150 mmHg, and 250 mmHg. In the pulse mode, the display is in relative amplitude, variable with the SIZE control.

3. Provides (in the pressure mode) zeroing for tranducer imbalance, with ZERO control on the front panel.

4. Provides (in the pressure mode) a 100 mmHg calibration check activated by 100 mm CHECK push button on front panel (100 mmHg display on 150 and 250 mm and overrange on 25 mm).

5. Provides an amplified pressure or pulse output signal to a rear-panel jack. In pulse mode, output amplitude varies with SIZE control setting.

6. Provides the readout conditioner with an amplified pressure signal for derivation of systolic, diastolic and mean values.

7. Provides an amplified pressure or pulse display signal. In the pressure mode, the display zero is offset three centimeters below screen center. In the pulse mode, the display baseline is positioned to the screen center when the ECG channel is off (single trace) or two centimeters below screen center when the ECG channel is also on (dual trace).

8. Provides a logic signal to indicate whether the Pressure/-Pulse channel is on or off. This signal goes to:

a. The Main Board, to allow display of the channel, either single or dual trace, depending upon the state of the ECG channel.

b. The ECG Board, to set the ECG display baseline position at the screen center for ECG only, and about two centimeters above screen center for dual trace.

9. Provides a logic signal to the digital readout so that the functions, Systolic/Diastolic and Mean, are displayed only when one of the pressure ranges is selected.

10. Provides a logic trigger signal that switches from LO to HI during the positive-going portion of a pressure or pulse waveform. This signal is used only when ECG is off, for:

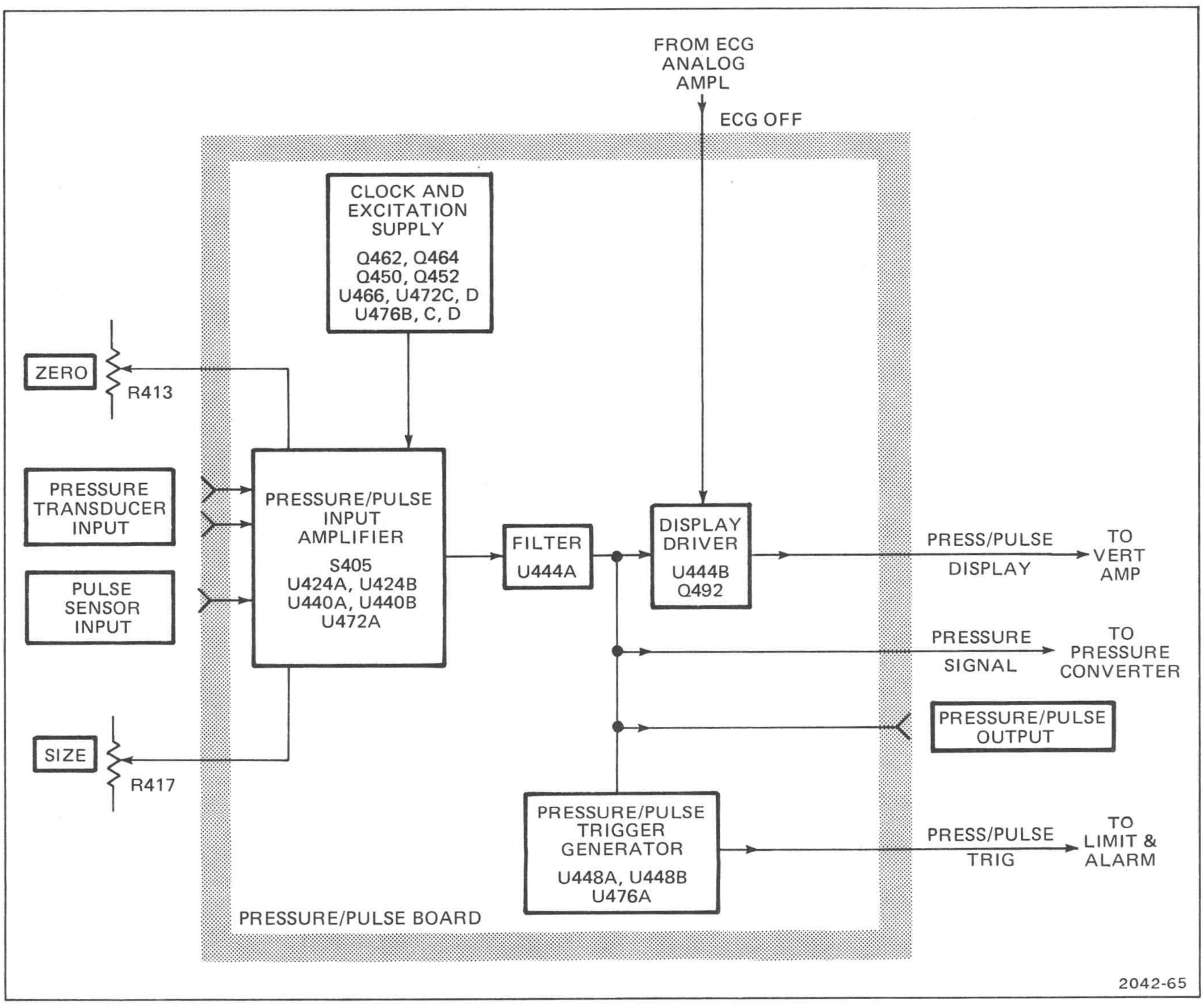


Fig. 3-4. Pressure/Pulse block diagram.

a. Sweep Trigger.

b. Rate Alarm.

c. Beat Tone.

d. Rate Digital Display when ECG is off.

e. Pulse Alarm (for Pulse mode only).

Pressure Mode Circuit Operation

The amplifier is chopper stabilized in the pressure mode (Fig. 3-5). The excitation voltage supplied to the pressure transducer is pulsed to provide part of the chopping signal to the amplifier. When the Pulsed Excitation Supply is off, the inputs to the high-gain amplifier (U424A and B) are effectively shorted together through the transducer resistance, creating a no-signal condition.

When the Pulsed Excitation Supply is turned on, a pulse whose amplitude is proportional to the pressure appears at the output side of the interstage coupling capacitor (C441).

SAMPLE AND HOLD. During the time that the Pulsed Excitation Supply is turned off (controlled by U476C and D) the interstage coupling capacitor (C441) is grounded through U427B (switch closed). Thus, any input amplifier offset, including drift, establishes a charge on C441. At this time U472A is open.

Shortly before the Pulsed Excitation Supply is turned on, U472B opens, removing the ground from C441.

Now, when the Pulsed Excitation Supply turns on, the pressure pulse appears at U440B output. Since the coup-

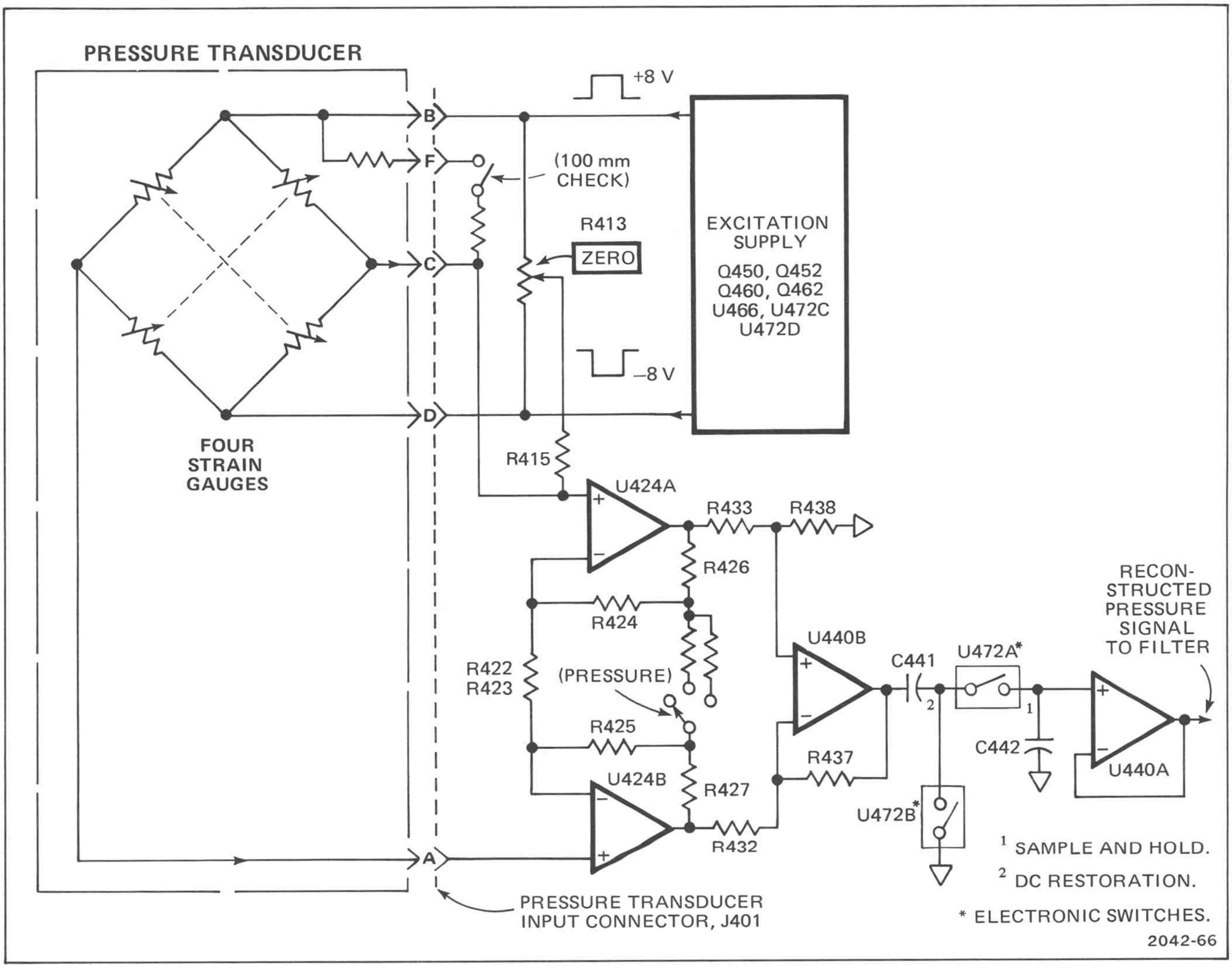


Fig. 3-5. Pressure/Pulse Amplifier in pressure mode.

ling capacitor was previously charged to the amplifier offset level, only the signal representing the pressure level is passed on (dc restoration).

The Sample and Hold switch (U472A) now closes, the holding capacitor (C442) charges to the new signal level. The Sample and Hold switch (U472A) then opens, the Pulsed Excitation Supply shuts off, and finally U472B closes and again grounds the coupling capacitor.

All amplification in the Pressure/Pulse channel precedes the interstage coupling capacitor. All subsequent stages are at unity gain. This method of amplification results in fewer operator controls. Since all dc offsets of the amplifier including drift are eliminated by this method, there is no need for a dc balance control. The only control required is ZERO, which corrects for residual imbalances in the pressure transducer and any unwanted pressure head due to elevation difference between patient and transducer.

PULSED EXCITATION SUPPLY. The Pulsed Excitation Supply consists of a pair of operational amplifiers, U466A-466B and two pairs of emitter followers, Q450-Q456 and Q460-Q462. The supply provides an adjustable + and − 8 volts (within 25%) output to power the pressure transducer bridge. This variable voltage provides the means of calibrating channel sensitivity (Gauge Factor).

This supply also provides a steady +3.75 volts to power the pulse transducer in the pulse mode.

When U472C is on (closed) the current in R472 is shunted away from the power supply and, therefore, the supply output voltage is established by feedback resistor R455 and the series combination of R457 and R456 to the −12 volt supply.

Components U466B-Q450-Q452 form an inverting operational amplifier. Zener VR452 shifts Q452-Q450 level down to that appropriate for the dynamic range of the operational amplifier U466B.

Resistor R453 supplies base current for Q452.

When transmission gate U472C opens, current is injected from R472 into the summing node, pin 6 of U466B. The R472 current is slightly greater than the current from the −12 volt supply via R456-R457, and the amplifier output tries to regulate to some negative voltage. When the output attempts to go negative, CR455 turns on and provides feedback to pin 6 of U466B, setting Q452 base at about −0.7 volts. Q452 and Q450 turn off, and the output level (at TP463) is essentially zero voltage.

When in the pressure mode, R458 current is diverted from the summing node through CR478-R474 to the +7 volt supply. When the mode is switched from pressure to pulse, R474 is disconnected from +7 volts. CR470 turns on, and the R458 current flows to the summing node (pin 6 of U466B) setting the output voltage (at TP463) at +3.75 volts. At the same time, +7 volts is applied through CR497 to the switching multivibrator, causing U476C, pin 11 to lock in the HI state. With the multivibrator disabled, the + output (TP463) becomes a steady +3.75 volts.

In the pressure mode, the other half (negative side) of the Pulsed Excitation Supply functions in exactly the same manner as the + side, except that it is referenced to the plus side so that it produces a voltage equal to the plus side, but of opposite polarity.

In the pulse mode, the negative side of the supply is held at zero voltage by current from R482.

PRESSURE INPUT AMPLIFIER. In the pressure mode, the Input Amplifier is connected as a differential-in-to-single-ended-out amplifier. The display ranges are changed by switching gain resistors R430 and R431 between U424A and U424B. The amplifier gain at each pressure range is approximately as follows: X125 at 250 mmHg, X208.3 at 150 mmHg, and X1250 at 25 mmHg.

Capacitor C422 adds substantial dc degeneration to the amplifier to keep the quiescent dc level low at the output of U440B. Since the amplifier is chopper stabilized, flat response to dc is not required.

Since the pressure channel cannot be turned off, operating without a pressure transducer plugged in will probably cause the amplifier to lock up in one direction. This puts a large charge on C422. When a pressure transducer is then plugged in, it may take several seconds to discharge C422. The diode-resistor networks CR434-CR435-R435 and CR436-CR437-R436 speed the discharge of C422.

In the pressure mode, the 100 mm CHECK push-button switch shifts the display by 100 mmHg.

The ZERO control R413, corrects transducer residual imbalance.

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ASTABLE MULTI. The astable multi, consisting of U476C and U476D and associated circuitry, provides the chopping signal that controls four transmission gates (electronic switches) U472A, U472B, U472C, and U472D.

The multi output at pin 11 of U476C is a 14 V peak-to-peak (—7 V to +7 V) non-symmetrical square wave. The negative duration of the waveform is about 5 times that of the positive portion. The multi typically freeruns at about 80 hertz.

CHOPPING EVENT SEQUENCES. Figure 3-6 shows the time relationships between the astable multi output and the transmission gates U472A, U472B, U472C, and U472D.

The chopping signal is applied to the transmission gate U472A through delay network C485 and R485. C485 permits only the closing of U472A to be delayed; the opening is not delayed.

The chopping signal is applied to U472C and U472D through delay network R475 and C475. The chopping signal is inverted in U476B and applied to U472B through delay network C483 and R483. C483 permits the closing of U472B to be delayed; the opening is not delayed.

Pulse Mode Circuit Operation

In the pulse mode, the amplifier system (Figure 3-7) is no longer chopper stabilized, but simply ac coupled. To do this, the Pulsed Excitation Supply is turned on steady state. The interstage coupling capacitor (C441), following the input amplifier is not intermittently grounded but is referenced to ground via R484. The switch that is part of the sample and hold circuit (U472A) is permanently closed. This method of operation is possible because frequency response down to dc is not required in the pulse mode.

PULSE INPUT AMPLIFIER. In the pulse mode, the Input Amplifier is ac coupled by C414 and connected for single-ended input to U424A. R428 is switched in to set the amplifier gain at approximately 900. Size control R417 provides an adjustable attenuator to set the desired pulse display amplitude. R417 has about 20:1 control range.

Diodes CR414-CR415 speed up the charging of C414 to provide quick overdrive recovery.

U472B remains open and U472A remains closed in this mode. The amplified pulse signal is coupled through C441, U440A, and U472A to the filter circuit. As previously stated, only the + side of the Pulsed Excitation Supply is used and is not pulsed as in the pressure mode.

Output Circuit Operation

The Pressure/Pulse output circuit (Fig. 3-8) provides an amplified pressure or pulse signal to the PRESSURE/PULSE OUTPUT connector, to the vertical amplifier for display on the CRT, and to the digital readout. A trigger is derived from the Pressure/Pulse signal to trigger the Sweep circuit when ECG channel is off.

Since the Pressure/Pulse signal output level (pin 1 of U444A) is twice the amplitude required for the pressure/pulse display,

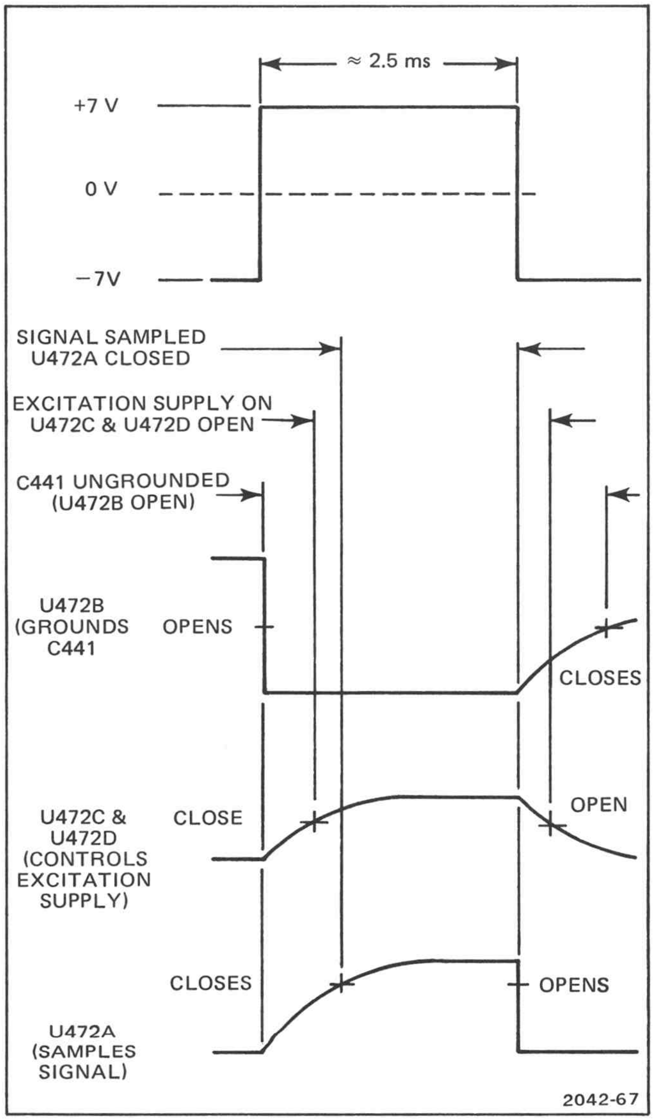


Fig. 3-6. Astable multivibrator and transmission-gate time relationships in pressure mode.

the signal is attenuated (by a factor of 2) by divider R499-R493. The attenuated signal is fed to pin 5 of the display driver (U444B).

DISPLAY POSITION CURRENT SOURCE. This circuit adds a dc level to the Pressure/Pulse display signal to position the display baseline for three modes: pressure, pulse only (single trace) and pulse with ECG channel on (dual trace).

Q492 collector supplies current to the summing junction R498/R499. The amount of current present at this junction is determined by three different conditions.

In the pressure mode, +7 volts is applied through CR498 to the junction of CR494/CR496, turning off CR494 and CR496. The 75 microamperes in R493/R495 (U492 emitter current) is injected into U444B summing junction, setting the display baseline at 3 cm below screen center.

In the pulse mode, with ECG off, CR496 is turned on, pulling 50 μA (through R492) away from U492 emitter. At the same time, the +7 volts applied to CR493 anode causes CR493 to conduct, pulling the 75 μA away from Q492 emitter. Q492 emitter (and collector) current is zero. With no current injected into U444B summing junction, the trace is positioned to screen center.

Now, when ECG is turned on, CR496 anode goes LO, CR496 turns off, and 50 μA (through R492) flows to the summing junction. This 50 μA positions the display baseline 2 cm below screen center.

BUTTERWORTH FILTER. Components R442, R443, C443, C444A, C444B, and U444A make up a 2-pole, low pass, Butterworth filter.

The primary purpose of this filter is to smooth the reconstruction of the pressure signal which is delivered by the sample and hold circuit. It also minimizes undesirable high-frequency noise in a pulse signal.

PRESSURE/PULSE TRIGGER. The Pressure/Pulse Trigger circuit converts the pressure or pulse signal out of the 20 hertz Butterworth Filter (U444A), to a step signal at U448A output. The step at U448A output is inverted by U476A.

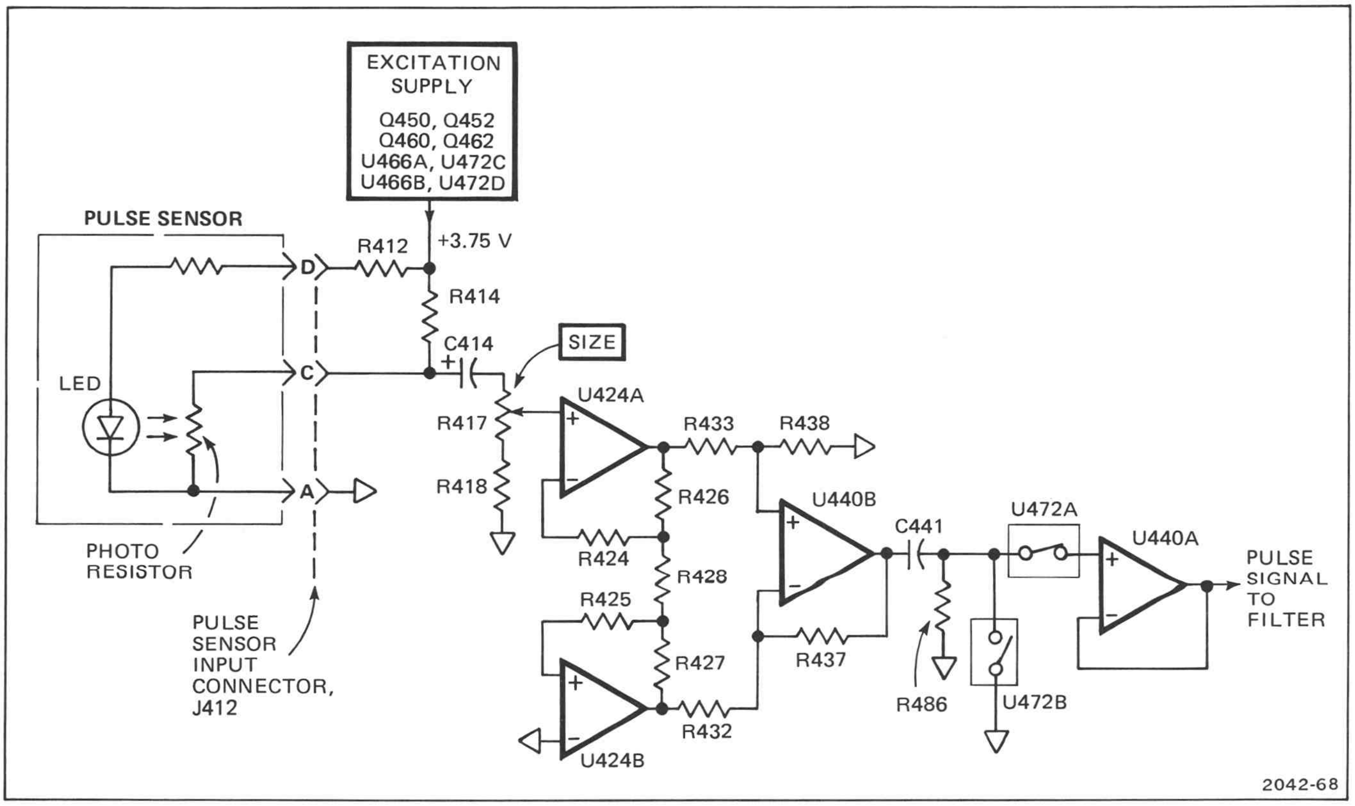


Fig. 3-7. Pressure/Pulse Amplifier in pulse mode.

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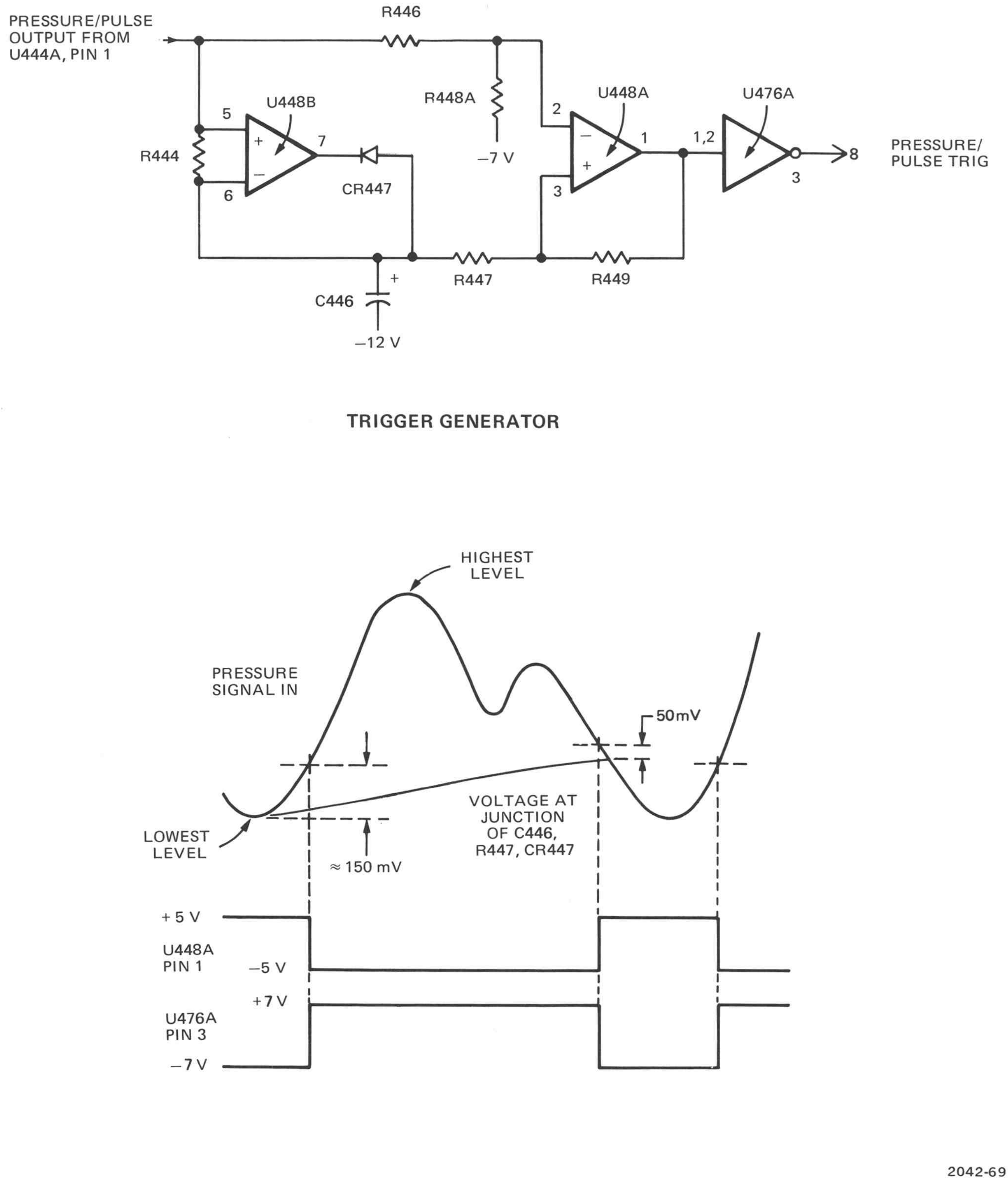


Fig. 3-8. Pressure/Pulse Trigger circuit showing time and approximate voltage levels.

The inverted step triggers the horizontal sweep, rate alarm, beat tone, and rate digital display.

The trigger circuit produces a positive-going step of approximately −7 to +7 volts at the inverter (U476A) output, at about 150 mV above the most negative excursion of the pressure or pulse signal. See Figure 3-8.

As the input signal goes negative, pin 5 of U448B is more negative than pin 6. Pin 7 goes negative, CR447 conducts, and the charge on C446 goes negative with the input on pin 5.

The input signal reaches its most negative excursion and starts positive. Since pin 6 is held at the most negative excursion of the input signal, and pin 5 starts positive, pin 7 goes positive and turns CR447 off.

Pin 2 of U448A is approximately 100 millivolts below the input signal due to current in R446 (set by R448 to −7 volts).

Pin 1 of U448A is HI (approximately +5 volts). The approximately 5 microamperes of R449 current through R447 sets pin 3 at about 50 millivolts above the voltage on C446.

When the input signal rises to about +150 millivolts (100 millivolts plus 50 millivolts) above its most negative excursion, U448A switches, pin 1 goes LO, and pin 8 of U476A goes HI. Since pin 1 of U448 has now dropped to about −5 volts, pin 3 goes to about 50 millivolts below the voltage on C446.

As the input signal continues to rise, C446 charges slowly in the positive direction, as shown in Figure 3-8.

The input signal reaches its most positive excursion and starts back down. Nothing further occurs until the level at pin 2 of U448A drops more negative than pin 3, i.e., when the input signal drops below a level 50 millivolts (100 millivolts minus 50 millivolts) above the voltage on C446.

Now, U448A switches back, pin 1 of U448A goes HI, and pin 8 of U476A goes LO. Thus, the trigger signal is a step related to the input signal, as shown in Figure 3-8.

MAIN BOARD ④ ⑤

Circuit Functions

The circuits on the Main Board accomplish the following:

1. Select the signal to be displayed depending on the status of the pressure/pulse and ECG channels. Provide electronic switching for dual trace when both channels are on. Provide crt blanking during each trace switching cycle.

2. Amplify the pressure/pulse or ECG signal to drive the vertical deflection coil.

3. Select trigger signal to be used. When the ECG channel is on, the ECG trigger signal is selected. When the ECG channel is off, the pressure/pulse trigger is selected. Selected trigger is used for sweep triggering, beat tone and rate alarms.

4. Provide a triggered sweep (front panel controls select 25, 50, or 100 mm/sec). A sweep generator signal is amplified by the horizontal amplifier to drive the horizontal deflection coil.

5. Provide audio tone for alarm sound or beat tone. The circuit is triggered by the selected trigger or gated by an alarm signal from the alarm limits board.

6. Provide an ECG LEAD CHECK signal to check patient cable continuity and ECG amplifier operation.

7. Provide power and signal distribution between the circuit boards. Power supplies provide +7 volts, −7 volts, +12 volts and −12 volts for all boards, and +35 volts, −35 volts, −50 volts, +175 volts and +3400 volts for the Main Board and crt circuits.

8. Provide battery or ac-line voltage to power the converter in the primary circuit. When the ac-line plug is connected to an ac outlet, the battery will be charging and the monitor will operate from the ac line when the POWER button is pushed in. When the ac plug is not connected, the monitor will operate from battery power.

Vertical Circuit Operation

The Vertical circuit (Fig. 3-9) amplifies the selected display signal and drives the vertical deflection coil. The circuit also provides dual-trace switching, crt blanking during the channel-switching interval, retrace blanking, and vertical

boost to supply the extra voltage required to change the vertical deflection-coil current quickly during the switching interval.

MODE SWITCHING. The Mode Switching circuit (Fig. 3-10) selects the appropriate display and trigger source signals, depending on the status of the ECG and pressure/pulse channels. During dual-trace operation, the Trace Chop Multivibrator (U652A and B) provides a 2 kilohertz logic signal to alternate the ECG and pressure/pulse signals. For mode switching logic, see Figure 3-10.

CHOP BLANKING MULTIVIBRATOR. The Chop Blanking Multivibrator provides crt blanking during the channel switching interval. The blanking multivibrator consists of U626B and associated circuitry (C632-R632). The multivibrator is a 120 microsecond, one-shot with triggering provided by the dual-trace switching signal from pin 11 of U622D and pin 10 of U622C. The multivibrator produces a positive-going step at Q when pin 10 of U626B goes HI. This positive-going step at Q turns off Q842 and Q844 in the crt blanking circuit, to blank the crt beam.

The Chop Blanking Multivibrator also enables the Vertical Boost Multivibrator, U626A.

VERTICAL AMPLIFIER. The Vertical Amplifier, U628A and its associated circuitry, is basically a voltage follower configuration of an operational amplifier as in Figure 3-11A. Output current is determined by R648, which loads the amplifier output as shown in Figure 3-11B. With the output current simply defined as output voltage divided by load resistance (R648), the vertical deflection coil is added in series with the amplifier output as in Figure 3-11C. Figure 3-11C is, therefore, the basic circuit for the vertical amplifier.

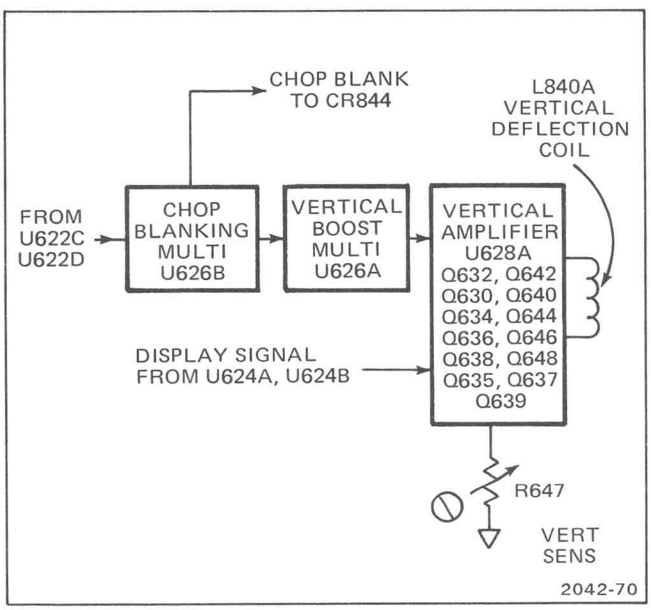


Fig. 3-9. Vertical circuit block diagram.

Transistors Q636, Q638, Q646, and Q648 are current boosters for the operational amplifier output. Q632 and Q642 provide the interface between the output of U628A and the boost transistors and allow voltage swing up to +35 volts.

The circuit consisting of CR628, Q631, and Q633 is a bi-directional voltage clamp on the input so that the amplifier does not try to establish unnecessarily high current levels in the vertical deflection coil.

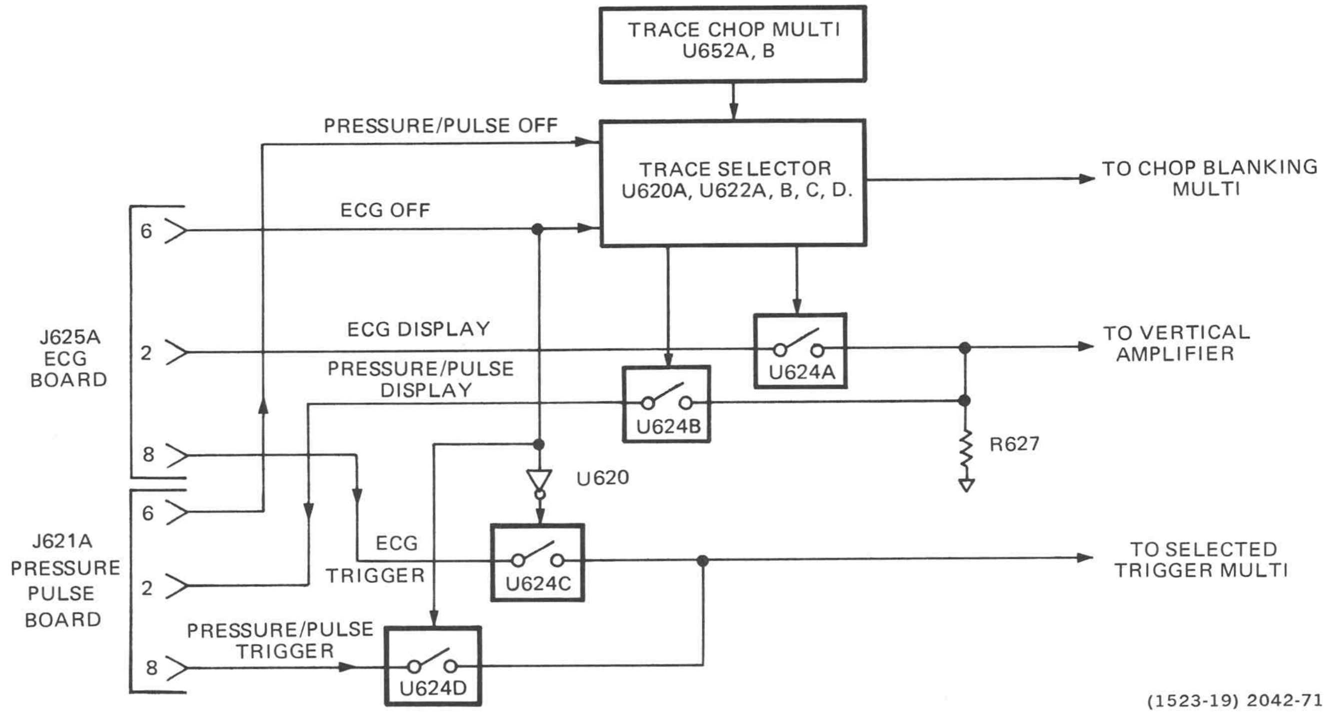
Some rapid changes at the input of U628A, such as the chop transition from one trace to another, cannot be followed instantaneously by the output. This can create a substantial difference between the input and the feedback. Therefore, the bi-directional clamp, (Q635 and Q637) limits Q632 and Q642 collector current to a value that is usable by the output stage.

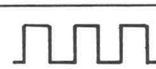
VERTICAL BOOST MULTIVIBRATOR. The Vertical Boost Multivibrator is a 70 microsecond one-shot (U626A) and associated circuitry (C636-R633).

The output from the Vertical Boost Multivibrator causes Q630, Q634, Q640, and Q644 to switch the amplifier power supply from + and −7 volts to + and −35 volts. This higher voltage decreases the time required for current to change in the vertical deflection coil.

When pin 12 ($\overline{Q}$) from Chop Blanking Multivibrator is HI, CR623 pulls pin 3, reset input, HI and U626A is enabled. This ensures that U626A is enabled each time chop blanking starts. If the collector of Q639 remains LO for very long, C623 discharges toward −7 volts, putting U626A in the clear condition so that it can not be triggered. The RC time constant (R634-C623) is such that the Vertical Amplifier, via Q639, tells U626A that it needs boost within about 15 milliseconds of the start of the chop blanking period. Otherwise, triggering of U626A is prevented and no boost occurs.

Actual triggering of U626A is accomplished via pin 2. Diode CR622 holds pin 2 of U626A LO between blanking intervals and U626A cannot be triggered.



DISPLAY SWITCHING	BOTH CHANNELS ON	ECG ON ONLY	PRESSURE/PULSE ON ONLY	BOTH CHANNELS OFF
ECG ON SIGNAL	LO	LO	HI	HI
PRESSURE/PULSE ON SIGNAL	LO	HI	LO	HI
U622B PIN 4			LO	LO
U622D PIN 11		**HI**	LO	LO
U622C PIN 10		LO	**HI**	LO
U622A PIN 3		LO		LO
ECG DISPLAY GATE U624D	OPENED & CLOSED ALTERNATELY BY TRACE CHOP SIGNAL	**CLOSED**	OPEN	OPEN
PRESSURE/PULSE DISPLAY GATE U624C		OPEN	**CLOSED**	OPEN
CHOP BLANK & VERTICAL BOOST MULTIVIBRATORS TRIGGERED	**YES**	**NO**	**NO**	**NO**

TRIGGER SWITCHING	BOTH CHANNELS ON	ECG ON ONLY	PRESSURE/PULSE ON ONLY	BOTH CHANNELS OFF
ECG TRIGGER GATE U624A	**CLOSED**	**CLOSED**	OPEN	OPEN
PRESSURE/PULSE TRIGGER GATE U624B	OPEN	OPEN	**CLOSED**	CLOSED

Fig. 3-10. Mode switching.

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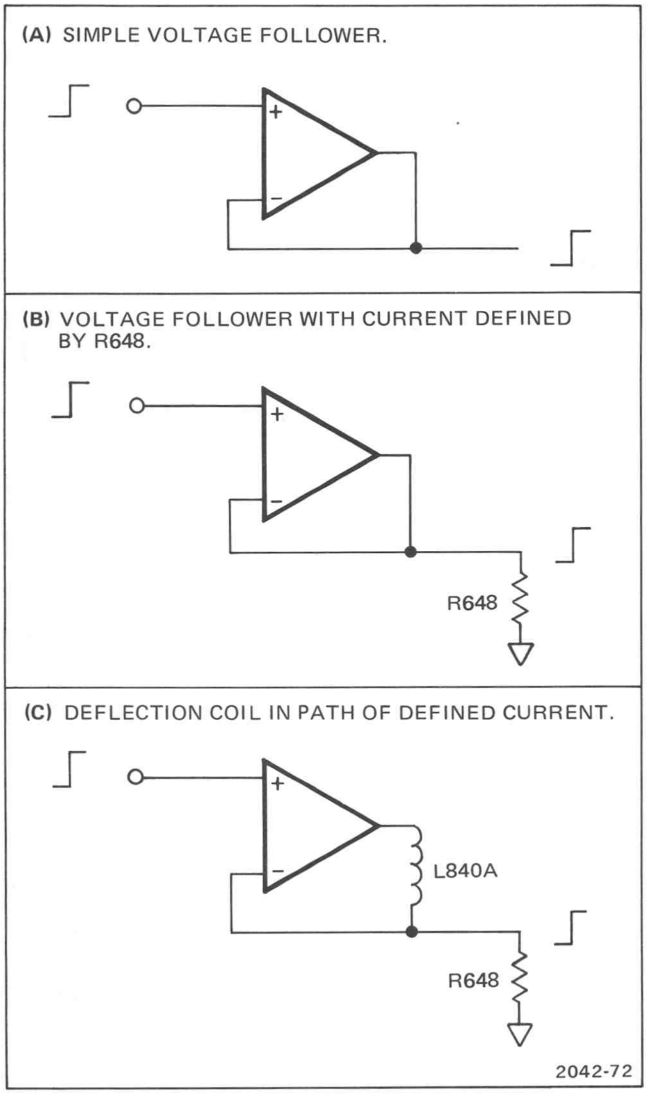


Fig. 3-11. Vertical Amplifier basic concepts.

When pin 5 (Q) of U626B goes HI, control of pin 2 of U626A now reverts to CR627 and Q639 collector.

When the amplifier demands voltage boost, because of a large step change, the base of Q639 goes LO (after some delay due to the slew rate limit of U628A output). The LO at Q639 base causes pin 2 (through CR627) to go HI, triggering U626A.

When U626A, pin 13, (Q) goes HI, the output supply voltage is switched from +7 volts to +35 volts, providing boost.

Only one boost may occur per chopping event due to the action of C627 and the fact that the multivibrator is an edge-triggered type. When pin 2 of U626A went HI, C627 charged to the higher level. The only discharge path for C627 is through CR622, which is turned on as soon as pin 5 of U626B goes LO again. Therefore, even through the signal at Q639 may go LO, pin 2 is held HI by C627.

The boost is terminated if the output no longer demands boost. When Q639 collector goes LO (controlled by signal from Q635-Q637), pin 3 of U626A is pulled LO after a slight RC (R634-C623) delay. This delay ensures that there really is no longer a need for boost (circuit won't respond to just a spike or two).

Horizontal Circuit Operation

The Horizontal circuit (figure 3-12) consists of a Trigger Multivibrator, a Sweep Free-Run Holdoff circuit, a Sweep Generator, and a Horizontal Amplifier to drive the horizontal deflection coil.

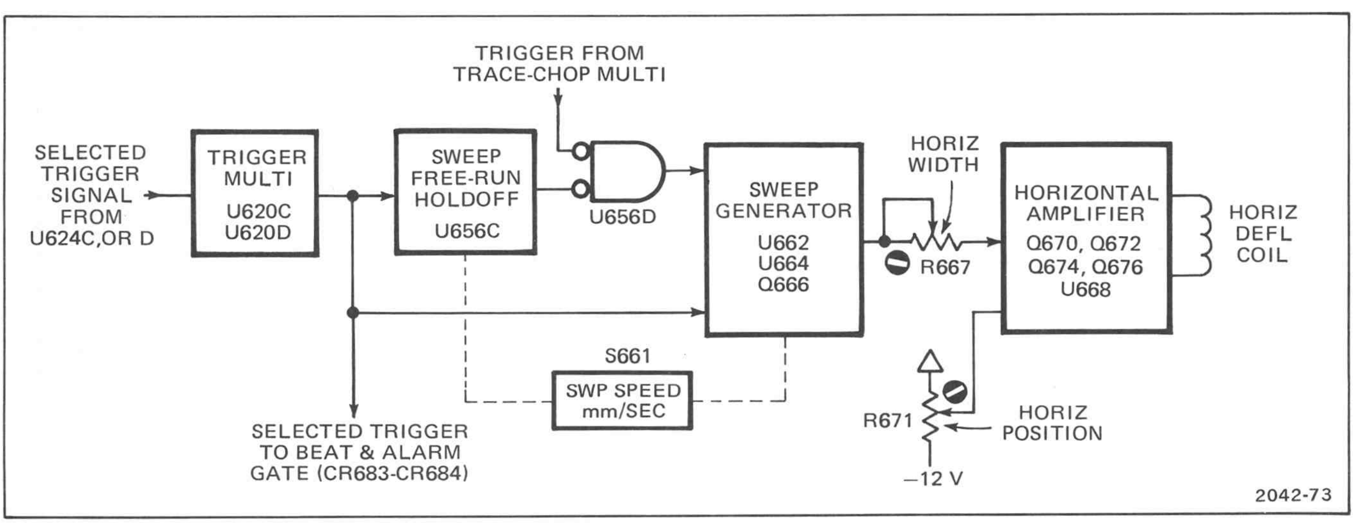


Fig. 3-12. Horizontal circuit block diagram.

The selected trigger signal is applied to the Trigger Multivibrator to produce a trigger pulse that is between 25 and 125 milliseconds in duration. This pulse is the selected trigger used for sweep triggering, beat tone, rate readout, and rate alarms.

If the trigger pulse has stopped for 3 to 6 seconds, the Sweep Free-Run Holdoff circuit discharges and allows the Trace Chop Multivibrator (U652A-U652B) to trigger the sweep, thus providing a baseline trace.

When the Sweep Generator is triggered, it produces a sawtooth signal that is amplified by the Horizontal Amplifier to drive the horizontal deflection coil.

SWEEP FREE-RUN HOLDOFF. When trigger pulses are present at pin 3 of U656A, C656 charges LO, making pin 12 of U656D HI and pin 6 of U656B LO. This allows the trigger signals on pin 5 of U656B to pass to the Sweep Generator. Should the trigger pulses stop for 3 to 6 seconds (C656 discharge time), pin 12 of U656D goes LO and pin 5 of U656B remains LO. The Trace Chop Multivibrator signal at pin 13 of U656D triggers the Sweep Generator to provide a base-line trace.

If R679 is removed, the 100 mm/sec sweep speed is no longer triggered (free runs). If R680 is removed, the 50 mm/sec sweep speed is not triggered. If a 1 kΩ resistor is added in the space provided beside R680, the 25 mm/sec sweep speed will be triggered.

SWEEP GENERATOR. The Sweep Generator is a Miller Integrator circuit; Q666 provides the reset function. The Miller Integrator begins run-up whenever pin 8 of U662C goes HI and changes the state of the R-S flip-flop (U662A, U662D). This turns off Q666 and run-up begins. When the voltage fed back to R662 causes pin 5 of U664B to go through 0 volts, the R-S flip-flop again changes the state and terminates the sweep.

HORIZONTAL AMPLIFIER. U668A and its follower transistors, Q670 and Q672, compose a conventional inverting-type operational-amplifier circuit. The deflection coil is operated in the voltage mode so that the coil current is determined by the voltage across the coil divided by the coil resistance.

The amplifier impresses a negative-going sawtooth at pin 2 of P641. That voltage is fed through R676 to the opposing half of the horizontal amplifier (U668B, Q674 and Q676). This sawtooth is inverted through U668B to impress a positive-going sawtooth at the other side of the horizontal deflection coil.

Audio Circuit Operation

The Audio circuit provides audible beat and alarm tones. Both tones are produced when the signal from the Trace Chop Multivibrator is gated to the Audio Amplifier circuit through CR683-CR684 or CR685-CR686.

Beat and Alarm Tone Gating

The beat tone is gated as follows: the trigger signal from the Trigger Multivibrator U620D alternately sets CR683 at −7 and +7 volts, turning CR683 on and off. When CR683 is off, the trace chop signal turns CR684 on and off, and the trace chop signal reaches the Audio Amplifier via the BEAT LOUDNESS control R692. When CR683 is on, CR684 is held LO and no signal reaches the Audio Amplifier.

When an alarm signal arrives via pin 4 of J625A, the HI at CR686 cathode turns off CR686 and the trace chop signal is gated through CR685 to the Audio Amplifier via ALARM LOUDNESS control, R695.

The result is an interrupted tone (at the trigger repetition rate) for beat and a continuous tone for alarm conditions.

AUDIO AMPLIFIER. The audio amplifier circuit consists of an amplifier U628B and two emitter followers Q692 and Q694. The audio tone signal enters either through the ALARM LOUDNESS control, R695, or the BEAT LOUDNESS control, R692, to be amplified and output through the 100 Ω voice-coil speaker.

ECG Lead Check Circuit Operation

The ECG Lead Check circuit provides an output pulse for checking patient cable continuity and ECG circuit operation. The circuit is a non-symmetrical astable multivibrator consisting of U652C and U652D. CR617 and R617 cause the non-symmetry. The output pulses are about 0.1 second wide and have a repetition rate of about 100 per minute. C614 gives the output pulses the appropriate rise and fall times to activate the QRS detector.

Power Supply Circuit Operation

The Power Supply operates from either a 115 or 230 Vac power line or from the internal battery. When the ac-power plug is connected to an ac outlet, a battery charging circuit is activated.

A battery-voltage monitoring circuit turns off the power supply inverter when the battery voltage drops to approximately 4.5 volts.

The −12 volt supply is regulated and adjustable by means of a primary regulating circuit. All other secondary voltages are regulated only to the degree imposed by the transformer turns ratio.

AC-LINE-VOLTAGE CIRCUIT. The ac-line-voltage transformer, T701, has two balanced primary windings. The windings are connected in parallel for 115 Vac operation and in series for 230 Vac operation. The transformer has two secondary windings. One supplies about 10.5 Vdc through CR703 to operate K721 relay and the battery charging circuit; the other supplies about 6 Vdc to power the converter.

When the ac plug is connected to an ac outlet, K721 closes to switch the power source from battery to ac and turn on the battery charging circuit.

BATTERY CHARGER. The charging circuit consists of Q712, Q714 and Q716. Charging current is supplied through R715, R716 and Q716. This current is limited to about 700 mA (about 400 mA in older instruments supplied with D-cell battery packs). The voltage developed across R715 and R716 turns on Q712, current is diverted from the base of Q714, thus regulating the current through Q716.

When the POWER button is pushed in (either on ac or battery), a positive voltage is applied to T801 primary center tap and to the emitter of Q726. Q726 conducts, turning on Q742 and Q744 to aid in starting the power-supply inverter. As the supply voltages build up, the +7 volts at R727 turns off Q726 because it is no longer needed to keep the inverter going. The inverter frequency is about 30 kilohertz.

BATTERY MONITOR. The battery monitor circuit monitors the internal battery voltage. If the battery voltage drops too low for reliable instrument operation, the circuit shuts down all of the supplies.

Well-charged batteries provide about 5.4 volts. The battery voltage is applied across R767 and the series combination of R766 and R765 to −12 volts. When the battery voltage is up, pin 2 of U746A is slightly above ground. Its output, pin 1, is negative and CR756 is off. When the battery voltage drops to a level that causes pin 2 of U764A to go slightly negative, the current in R764 reverses. This current reversal forces pin 5 of U764B positive. Due to positive feedback through R762 and CR762, pin 7 of U764B goes to nearly +7 volts. CR756 turns on, charging C755, turning Q754 on. Q742 now turns off, which stops all base current to the power-supply inverter and shuts down all supplies. C755 holds Q754 base positive long enough to make sure the supplies are completely off.

The diode CR733, between the junction of R756-R766 and Zener VR733 is backup for the shutdown circuit. In the event that the −12 volt supply goes out of regulation before the battery drops to the level at which shutdown should occur, pin 2 of U746A might never go negative. Diodes CR733-VR733 prevent this condition by clamping the junction of R765-R766 at about −5.6 volts.

When operating on ac, a positive voltage turns on CR752 and saturates Q756, which holds off Q754 to lock out the effects of a low-battery condition.

POWER SUPPLY REGULATION. Q734 and Q736 make up a common comparator circuit to regulate the power-supply inverter current as referenced to the −12 volt supply. As the −12 volt supply changes, the collector of Q734 reflects the change and through Q742, adjusts the inverter current to readjust the secondary output voltages.

Crt Circuit Operation

CRT. The crt has electrostatic focus and electromagnetic deflection. The cathode is directly heated for good efficiency and fast warmup. The intensity is fixed because the beam current is maintained constant. R841, Focus adjustment is provided to obtain best spot focus.

V840 (crt), Q842 and Q844 form a feedback circuit which sets the crt grid voltage to any required level so that the crt cathode voltage is held very close to ground. This fixed cathode voltage results in a constant beam current of about 6 microamperes for single trace or about 16 microamperes for dual trace. When the anodes of CR847 and CR848 are LO (indicating dual trace), the beam current is increased from 6 to 16 microamperes.

BLANKING CIRCUIT. The crt is turned off during sweep retrace and dual-trace switching intervals. This is accomplished by positive-going blanking pulses applied through CR844 and CR845 to the base of Q844. The positive pulses turn off Q844 and Q842 allowing the collector of Q842 to go to −50 volts which cuts off the crt beam current. The crt cathode remains near ground potential due to C843.

READOUT CONDITIONER BOARD ⑥ ⑦ ⑧

Circuit Functions

The Readout Conditioner circuits (Figure 3-13) accomplish the following:

1. Provides a Rate Converter that converts the trigger (derived from ECG, pressure, or pulse signals) to dc voltage levels related to the average beat rate.

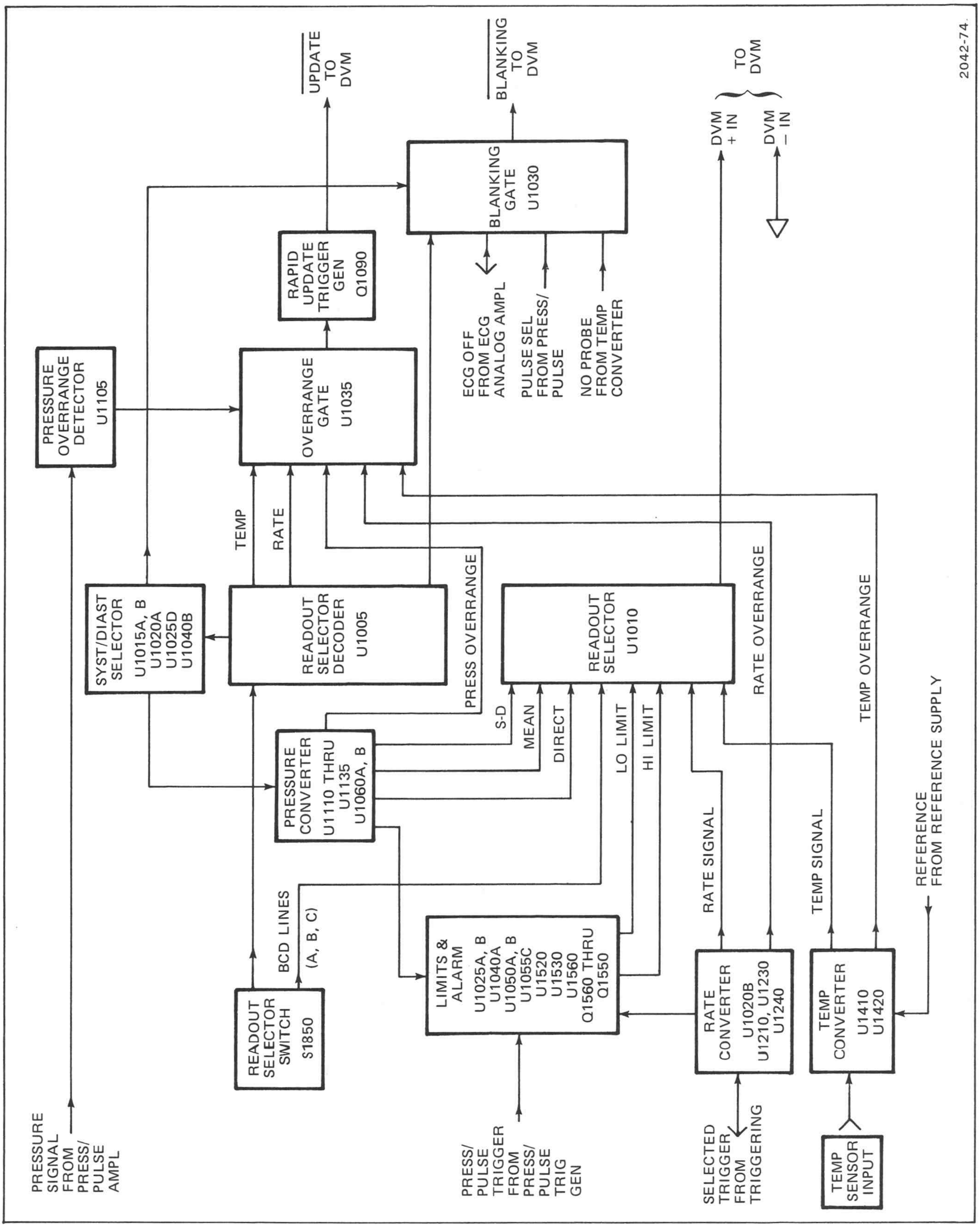


Fig. 3-13. Readout Conditioner block diagram.

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2. Provides a Temperature Converter that converts the signal from the Temp Sensor Input to dc signal levels directly related to temperature.

3. Provides a systolic-diastolid Pressure Converter that samples and holds the peak values of systolic and diastolic pressures. The filtered output provides a dc level (for each pressure) that is directly related to the average systolic or diastolic pressure level measured by the pressure transducer.

4. Provides a filter that produces a voltage representative of the mean value of the pressure signal.

5. Provides a means of selecting the desired functions via a Readout Selector and readout selector decoder using a binary coding system.

6. Provides an alarm system that produces both visual and audible alarms, as well as provision for an external alarm. The alarm operates if the beat rate goes above or below the limits set by front-panel controls, or if the difference in systolic and diastolic pressures falls below about 15 mmHg.

Also provides an alarm latch that can be reset to clear the alarm either from the front panel or from an external reset switch.

Circuit Operation

RATE CONVERTER. The Rate Converter is basically a one-shot multi (multivibrator) that is fired at every heartbeat. The one-shot multi output controls two CMOS switches that gate either ground or −12 volts into the four-pole filter. The filter output ranges between 0 volt for no heartbeat to +3 volts for a beat rate of 300 per minute, or more.

U1210A is a 1 millisecond one-shot multi that receives its signal from the trigger selector, pin 8 of J623A. When U1210A receives a positive trigger from the trigger circuit, Q (pin 13) goes HI for 1 millisecond. This 1 millisecond HI closes CMOS switches U1240C and D for 1 millisecond, discharging any charge on C1215, the timing capacitor for U1210B. At the end of the 1 millisecond timing cycle, when pin 13, U1210A goes LO, U1210B timing cycle starts. U1210B is a 200 millisecond one-shot multi. Its output pin 5 (TP1210), steps HI at the start of the timing cycle. This HI at pin 5 closes CMOS switch U1240B, connecting −12 volts (through R1234) to the input of the four-pole filter. The filter output is therefore proportional to the average rate of the 200 millisecond pulses.

If another trigger signal arrives before the end of U1210 200 millisecond timing cycle, a new 1 millisecond step at U1210A causes U1240C and D to short circuit C1215 and retrigger U1210B, and a new timing cycle starts.

If the input beat rate exceeds 300 beats per minute, U1210B stays on and the filter input (junction of R1240-C1240) holds at +6 volts. The filter output stays at +3 volts (3000 millivolts) which is divided by 10 in the switching circuitry. This produces a DVM reading of 300 (300 beats per minute).

If the beat rate is over 300 per minute, the LO at U1210B pin 12 enables U1020B, so that additional 1 millisecond pulses from U1210A pin 13 trigger U1020B, producing an overrange signal to the switching circuit to flash the display. The display reads out 300 beats/minute maximum because the filter output can never go above 3000 millivolts.

The filter is a four-pole Butterworth filter with each of the poles having a 1-second time constant. U1230 is an inverting feedback amplifier which also serves one of the filter poles (R1244-C1244). U1230B is a follower which serves as part of pole 4 of the filter.

The first pole of the filter consists of R1240 in parallel with either R1234 or R1236 (depending on which of the CMOS switches is closed), and C1240.

Components R1232, CR1232, and CR1230 prevent U1240B pin 4 from dropping below −7 volts.

CAL RATE control sets the time that Q (pin 5, U1210B) is HI in order to calibrate the rate converter.

TEMPERATURE CONVERTER. The Temperature Converter circuit converts the probe temperature to a voltage that can be used by the DVM.

The temperature probe contains two thermistors and produces, with some external circuitry (the +1.76 volt supply and R1407-R1412), a linear voltage vs. temperature curve.

The linear range is −5° to +45° C (23° to 113° F).

The +1.76 volt supply is derived from a reference supply on the DVM Board via P2300, pin 1. U1410C is a follower that provides a high-impedance load to R1410 and a low-impedance out to the temperature circuitry. R1410 adjusts the temperature span by setting the probe supply to +1.76 volts.

U1410A is an impedance matching feedback amplifier, to match the probe impedance to the other circuitry.

U1410D provides the correct amplification to produce 10 millivolt/degree to the DVM. The °F and °C ranges require different amplification (°F is 1.8 times °C). Resistors R1427 and R1428, in conjunction with the °C-°F switch provide that amplification change.

Resistors R1408, R1424, and R1420, in conjunction with the °C-°F switch provide the 32° offset difference for °C and °F ranges.

Resistor R1424 calibrates the °F range and R1420 calibrates the °C range (fine adjusts the offset).

Components U1420A and B and R1430-R1432-R1434 provide the overrange detection circuit. Integrated circuit U1420A and B are comparators. The input voltages are set to the ends of the temperature ranges. If the temperature goes beyond the linear range, the output of U1420A or B goes HI. This HI to the switching circuit causes the display to flash.

The No Probe detection circuit is actuated via an extra set of contacts on the temperature probe input jack, J1410. If the probe is not connected, pin 5 of U1410B goes HI. This produces a HI at pin 7 of U1410B, and to the No Probe output to the switching circuit, which blanks the readout display.

SYSTOLIC/DIASTOLIC CONVERTER. The Systolic/Diastolic Converter is a sampling circuit, followed by a two-pole filter. This circuit determines the peak and valley values of the pressure waveform, and through the sampling and filter system, converts these pressure levels to voltage to be read by the DVM.

U1120A and D are trigger circuits that tell when to take the sample. Switches U1130A and C are the sample and hold switches and C1112 and C1122 are the final storage capacitors that provide signal to the filter.

When the incoming pressure signal (from pin 6 of U1110) is rising, pin 3 of U1120A rises. The rise at pin 3 causes pin 1 to rise. CR1051 conducts and charges C1050 to the value of the rising signal.

During this period of rising input signal, since pin 5 of U1120B is HI, pin 7 goes HI and switch U1130A closes. Thus, the rising signal at pin 3 of U1115A (voltage follower) charges C1120 to the input level.

As long as the input pressure signal is rising, pin 14 of U1120D is LO, pin 8 of U1120C is LO, switches U1130B and C are open.

At the peak of the rise (systolic), C1120 is now charged to that peak level (a sample is taken).

Now, when the pressure signal starts to fall, pin 1 of U1120A goes LO, because pin 2 is held at the highest level by C1051 while pin 3 falls. Diode CR1051 turns off, pin 7 of U1120B goes LO, opening switches U1130A and C. The sample is now stored in C1120. Since there is no R associated with C1120 (except leakage current in U1115B), C1120 holds the highest value of the pressure signal.

As the pressure falls, pin 12 of U1120D falls, pin 14 of U1120D falls, CR1061 turns on, and C1061 charges toward the pressure signal level. As pin 14 of U1120D falls, pin 8 of U1120C goes HI, closing switches U1130C and B. C1110 now charges toward the pressure input signal level via U1115D. At the same time, since U1130B is now closed, the voltage on C1120 is transferred to C1122 and the systolic sample is fed to the two-pole filter U1135C and associated circuitry.

Since U1130D is open, the diastolic sample is not connected to the two-pole filter, U1125D and associated circuitry.

When the input pressure signal reaches the lowest value, C1110 is charged to that value.

As the input pressure now starts to rise, pin 14 of U1120D goes HI because pin 13 is held to the lower level by C1061 while pin 12 rises. Diode CR1060 turns off, pin 8 of U1120C goes LO, switch U1130C and B open, and the diastolic sample is now the voltage on C1110.

At the start of the input pressure rise, pin 1 of U1120A again goes HI, pin 7 of U1120B goes HI, switch U1130D closes, the voltage on C1110 is transferred to C1112, and the diastolic sample is fed to the two-pole filter U1125D and associated circuitry.

U1130A again closes and a new cycle starts.

Output from the two-pole filters is fed to the pressure alarm circuit and to a pair of switches U1060A and B. These switches are controlled by the Systolic/Diastolic Selector via pins 12 and 13 of U1015B. The switch outputs are tied together and fed to pin 5 of the Readout Selector, U1010.

When the Systolic/Diastolic function is selected, the Systolic/Diastolic levels are multiplexed out to the DVM.

The circuit responds to the peak and valley values (systolic and diastolic) while rejecting normal dicrotic notch level changes.

The discharge rates of C1050 (systolic) and C1061 (diastolic) are such that the systolic and diastolic switching points are as shown in Figure 3-14.

Resistors R1050 and R1061 ensure that whenever there is no pulsatile pressure (systolic minus diastolic = 0), all levels decay to the static incoming pressure.

MEAN PRESSURE FILTER. The Mean Pressure Filter is a four-pole passive filter consisting of U1110, U1135A, U1135B, and associated components.

The four-pole filter is designed to provide an accurate mean value of the pressure signal while holding ripple to 1 mmHg, or less.

The operational amplifiers provide impedance matching: U1110 presents a high-impedance load to the pressure signal attenuator and limiter circuit, and low impedance out to the first pole of the filter. Since the impedance of the second pole is too high to drive the third pole, U1135A provides the impedance interface. U1135B provides the low impedance to drive the readout selector input, pin 6 of U1010.

NEGATIVE PRESSURE LIMITER. All of the filters in the pressure converter circuits use polarized tantalum capacitors (ground reference). The Negative Pressure Limiter circuit, CR1033-CR1034-R1033-R1034 prevents excessive reverse voltage on these capacitors.

SWITCHING. The Switching system is designed around the Readout Selector U1010 and the Readout Selector Decoder U1005.

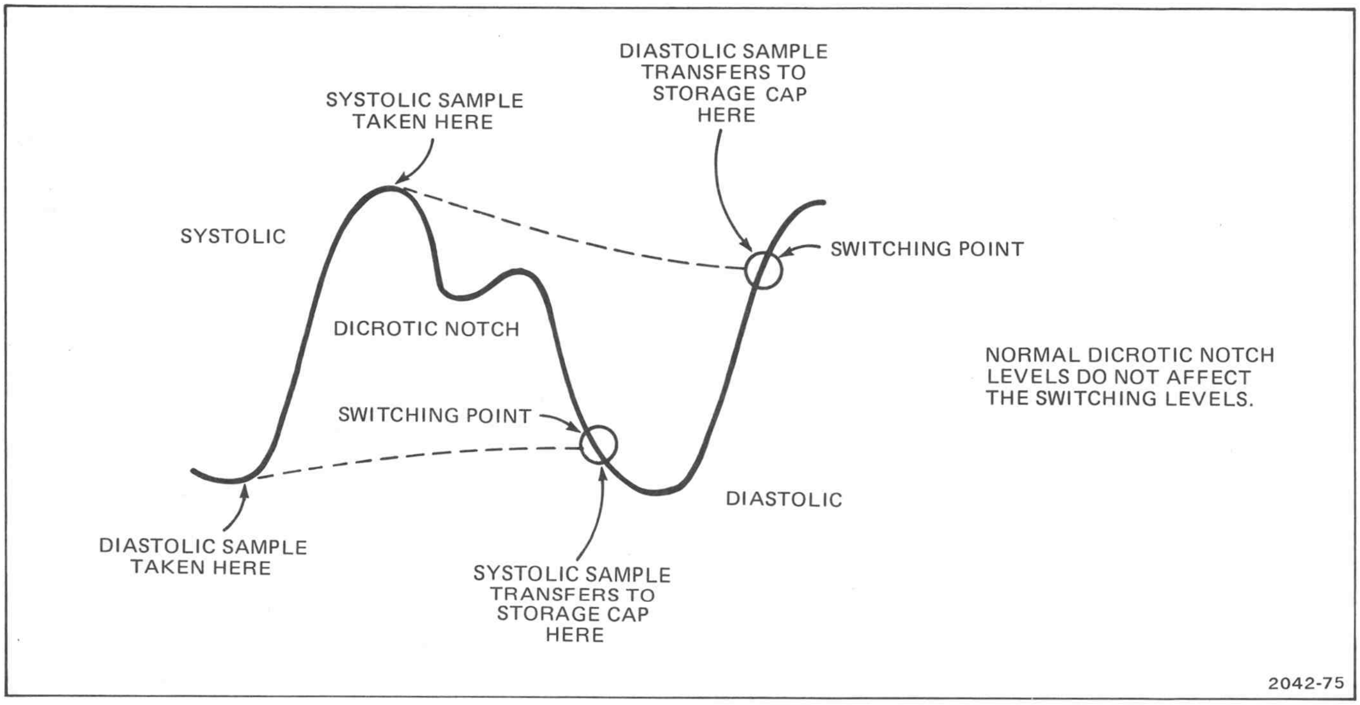


Fig. 3-14. Systolic/Diastolic switching points.

TABLE 3-1
Switching System Logic

READOUT SELECTOR DECODER U1005						READOUT SELECTOR U1010				
D	C	B	A	DEC	FUNCTION	C	B	A	DEC	FUNCTION
HI	LO	LO	LO	0	INHIBIT U1010 BLANKS DISPLAY	LO	LO	LO	0	LO LIM
LO	LO	LO	HI	1	------	LO	LO	HI	1	HI LIM
LO	LO	HI	LO	2	TEMP	LO	HI	LO	2	TEMP
LO	LO	HI	HI	3	RATE	LO	HI	HI	3	RATE
LO	HI	LO	LO	4	AUX	HI	LO	LO	4	AUX
LO	HI	LO	HI	5	SYST-DIAST	HI	LO	HI	5	SYST-DIAST
LO	HI	HI	LO	6	------	HI	HI	LO	6	MEAN
LO	HI	HI	HI	7	ZERO (PRESS)	HI	HI	HI	7	PRESSURE

These devices are controlled by binary lines A, B, C, and D. Each of the binary lines is actuated from a number of sources: The Readout Selector switch, the LOW RATE LIMIT (PUSH), HIGH RATE LIMIT (PUSH), and ZERO (PUSH). See Table 3-1 for the binary code, decimal equivalent, and function.

When the HIGH RATE LIMIT and LOW RATE LIMIT knobs are not pushed in, pins 5 and 6 of U1055B are both LO. Therefore, pin 4 of U1055B is HI (+7 volts) and this +7 is applied to the Readout Selector switch (S1850). Pushing one of the buttons on the Readout Selector switch applies +7 volts to one or more of the binary lines A, B, or C to select the desired function in both U1005 and U1010. For example, if RATE button is pushed, +7 volts is applied to binary lines A and B.

In U1005 the HI on A and B produces a HI on pin 15 (RATE). In U1010 the HI on A and B connects pin 12 to pin 3, connecting the rate signal (dc level) through to the DVM via R1070-R1072 and U1060C.

Integrated circuit U1035 is an AOI (and-or-invert) gate. This gate is the Overrange Gate. If an overrange signal (HI) is applied to one input of an AND portion of the gate, and if that function has been selected, the other input to this AND gate is HI, causing pin 3 to go LO. This LO on pin 12 of U1040D enables the Rapid Update Trigger Generator.

The Rapid Update Trigger Generator consists of a programmable-unijunction transistor and its associated circuitry. The trigger generates a pulse every 200 milliseconds. That pulse goes to the DVM which changes the normal updating from once/second to 5 times/second. When there is no signal (HI) on pin 7 of P1000 (the $\overline{\text{Update}}$ line) update occurs once/second. A LO on $\overline{\text{Update}}$ causes rapid update.

Rapid update can also come from a LO on pin 10 of U1025C.

U1025C gets it input from either of two sources: pushing the readout ZERO sets up a binary ABC to the decoder. Decimal 7 (pin 4 of U1005) goes HI and produces a LO at pin 10 of U1025C; or, pushing either LOW RATE LIMIT or HIGH RATE LIMIT puts a LO on pin 5 or pin 6 of U1055B. Pin 4 of U1055B goes LO, pin 12 of U1050E goes HI, and pin 10 of U1025C goes LO.

Therefore, pushing readout ZERO, or pushing either HIGH RATE LIMIT or LOW RATE LIMIT causes rapid update. At the same time, pushing LOW RATE LIMIT removes the HI from S1850, making binary lines A, B, and C LO, gating the low limit signal from U1520, pin 7 through the multiplexer to the DVM.

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Pushing HIGH RATE LIMIT removes the HI from binary lines B and C and puts a HI on line A, gating the HI limit signal from U1520C, pin 8 through Readout Selector to the DVM.

The Pressure Overrange Detector consists of U1105A and B and associated circuitry. The detector is a pair of comparators that compare the incoming pressure levels (dc) to fixed voltages set by the divider R1027, R1026, and R1028. The pressure signal is direct pressure and is not attenuated. The comparison level is such that an overrange signal is produced if the display (even a spike) goes off screen.

Since the filtered pressure signals are average signals, even an off-screen spike might change the average significantly.

If the overrange detector produces an overrange signal (HI) to pin 6 of U1035, and, if pressure has been selected (a HI on binary line C), U1035 output, pin 3 goes LO and provides a rapid update signal from Q1090.

The Systolic/Diastolic Selector (a three-state switch) consists of U1015A, U1015B, and U1020A. The selector changes states each time a positive-going signal arrives at pin 3 of U1015A.

If the Systolic/Diastolic (pressure) has been selected (HI on pin 6 of U1005), pin 8 of U1030 enables the blanking gate. At the same time, the HI is applied to pin 14 of U1050F, pin 15 goes LO, putting a LO on pin 5 of U1040B. Pin 6 of U1040B goes LO if pin 3 of U1035 goes LO on overrange. A LO at either U1040B input produces a HI at pin 3 of U1020A and this one-shot multi is enabled. When a positive-going edge comes in on the sample line from the DVM, the one-shot U1020A is fired, pin 4 steps LO and this LO applied to pin 11 of U1030 causes a blanking (LO) signal to pin 6 of P1000.

The DVM sample also causes U1015A and B to change states to provide the correct display sequence and blanking intervals.

Integrated circuits U1015A, U1015B, and U1025D make up a three-state multi to switch the Systolic/Diastolic gates U1060A and B to alternately read out systolic and diastolic pressures, and provide blanking between sets of readings. U1020A provides a 100 millisecond blanking interval between systolic and diastolic readings.

Gates U1060C and D provide switching to attenuate all of the Readout Selector output signals, except temperature, by a factor of ten, since these signal levels are ten times the level required by the DVM.

When temperature is selected (HI on binary line B) pin 2 of U1005 is HI, U1060D closes and U1060C opens, thus feeding the temperature signal out of the Readout Selector to the DVM unattenuated.

When any signal other than temperature is selected, pin 1 of U1005 goes LO, U1060D opens, U1060C closes, and the signal out of the Readout Selector is divided by ten before going to the DVM.

SIGN-ENABLE GATES. These gates determine whether the sign information in the DVM is presented to the readout.

When temperature or pressure is being measured, a + or – sign must be displayed. For rate, the sign has no meaning so sign information is not displayed.

When temperature is selected, the HI at pin 13 of U1055D (from pin 2 of U1005) causes a LO on the Sign Enable line to tell the DVM to display the sign information.

When pressure or AUX is selected, binary line C is always HI, indicating that one of the last four states 4, 5, 6, or 7 has been selected. If, in addition, the AUX line (4) has not been selected, then one of the pressure modes (5, 6, or 7) has been selected. The HI on pins 8 and 9 of U1040C (AUX LO inverted by U1050D) make pin 10 of U1040C LO. Pin 6 of U1050C goes HI, again causing a LO on the Sign Enable line.

DECIMAL POINT SELECTION. This circuit determines which, if any, decimal point is displayed.

When temperature is selected, the HI on pins 1 and 2 of U1055A cause a LO at pin 3. This signal is fed to the DVM via pin 8 of P1000 and enables decimal 2.

Decimal point 4 is displayed in the AUX mode, which is reserved for future use. If the binary input lines select the AUX code, pin 1 of U1005 goes HI. This HI is also a HI on pin 9 of U1050D. Pin 10 of U1050D goes LO, putting an active LO on pin 10 of P1000, thus enabling decimal 4.

ALARMS. The Alarm circuit consists of a voltage supply U1530B, a pair of feedback (follower) amplifiers U1520B and C, and a pair of comparators U1520A and D. In addition, there is some other logic to bring in other functions, including a Pulse Alarm Detector U1530A, U1040A, and U1560D.

There are also provisions for visual alarms, pulse and rate alarm on-off, alarm reset (internal and external), and a current source for an external alarm.

U1530B and associated circuitry provide +2.4 volts to the HIGH RATE LIMIT and LOW RATE LIMIT controls. The HIGH RATE LIMIT control provides a range of 90 to 240 beats per minute and the LOW RATE LIMIT control provides a 0 to 150 beats-per-minute range.

The Rate Limit controls set voltages at pin 5 of U1520B and pin 10 of U1520C. These two feedback amplifiers are voltage followers, to provide low impedance drive to the Readout Selector (U1010) inputs, pins 13 and 14. They also drive the comparators U1520A and D.

The drives to the Readout Selector provide DVM readout of the rate alarm limits and eliminate the control linearity problems of reading limits from limit-control position relative to front-panel scales.

The same voltages that drive the Readout Selector are fed to the Rate Limit Comparators, pin 2 of U1520A and pin 12 of U1520D. These comparators simply compare the level from the Rate Limit controls with the rate signal (dc level from the Rate Converter) from pin 7 of U1230B.

Whenever the rate signal from U1230B (pin 7) goes below the lower limit set by the LOW RATE LIMIT control, or above the limit set by the HIGH RATE LIMIT control, U1560D is enabled. Pin 11 of U1560 goes HI, CR1520 turns off and C1250 charges toward +7 volts. When the threshold at U1560C is crossed, pin 10 of U1560C goes LO. Pin 4 of U1560B goes HI, pin 10 of U1055C goes LO, and pin 1 of the flip-flop (U1025A and B) goes HI and the flip-flop latches in the alarm condition.

Once the flip-flop is latched to the alarm condition it holds that condition until reset.

The Rate Alarm can be disabled by turning the LOW RATE LIMIT control fully counterclockwise. This puts −7 volts on pin 8 of U1560C, inhibiting U1560C.

The Pulse Alarm signal is disabled in the out position of the PULSE ALARM button. In the out position, −7 volts is applied to pin 2 of U1560A, which inhibits U1560A, preventing the pulse alarm from reaching U1560B.

When no pulse alarm condition exists on the inputs to U1530A or U1040A, the outputs (pin 1 of U1530A and pin 3 of U1040A) are held LO. CR1535 and CR1536 are turned on, holding pin 1 of U1560D in the LO state, and U1560 is inhibited.

When the PULSE button is pushed in, pin 1 of U1040A is HI. If a pulse trigger is present, pin 2 of U1040A goes HI for every trigger pulse, causing pin 3 to go LO often enough to keep C1535 discharged to −7 volts. Thus, no pulse alarm condition exists.

Also, when the PULSE button is pushed in, the pressure signal is disabled. Therefore, the pressure signal (dc level) out of the Systolic/Diastolic Converter is zero. Pin 2 of U1530 is more negative than pin 3 due to R1530/R1534 divider, so pin 1 of U1530A is HI and CR1535 is turned off, permitting a pulse alarm from U1040A. Now, if the pulse trigger signal ceases, pin 2 of U1040A remains LO and pin 3 remains HI, thereby shutting off CR1536. This allows C1535 to charge toward +7 volts, thus enabling U1560A and setting the alarm flip-flop by way of U1560B, U1055C and U1050B.

If the PULSE button is out, pin 1 of U1040A is LO. Regardless of the condition of pin 2 of U1040A, pin 3 is HI and CR1536 is turned off.

If the systolic pressure falls below a level that is 10 to 15 mm_{Hg} above the diastolic pressure, pin 1 of U1530A goes HI. CR1536 turns off and C1535 charges toward +7 volts. With the PULSE ALARM switch ON, both inputs of U1560D are HI, pin 3 is LO and the alarm latch flip-flop switches to the alarm condition and latches until reset.

When the PULSE ALARM button is released, a negative step from C1538 via R1538 pulls Q1510 base LO, putting a HI on U1025B, and the flip-flop resets. Similarly, when the RATE ALARM is turned off, the alarm flip-flop will be reset via C1528 and R1528.

The alarm lamp is driven by Q1540. When the flip-flop (U1025A and B) is latched in the alarm condition,

the base of Q1550 is HI. Q1550 emitter pulls up, Q1540 collector goes negative, and the ALARM lamp lights. The output of Q1550 also goes to J623A on the Main Board to activate the audible alarm.

Q1520 and Q1530 act as a current source to drive the external alarm. When Q1540 collector goes negative, Q1530 and Q1520 turn on, and the current is fixed by R1557 and the feedback circuit, at 15 milliamperes.

DVM BOARD ⟨9⟩

Circuit Functions

The Digital Voltmeter circuit accomplishes the following:

1. Provides the circuitry to convert the dc input levels from the Readout Conditioner Board to a digital display.

2. Provides the polarity switching to set + input of the DVM Analog IC (integrated circuit) positive, regardless of the polarity of the input.

3. Provides a reference voltage for the DVM Analog IC and to the Temperature Converter circuit.

4. Provides digital display blanking to prevent display during certain intervals that might give an erroneous or unusable display.

5. Provides leading zero suppression.

6. Provides decimal point drive.

7. Provides two clock signals, Sample and Display.

8. Provides power supplies for digital voltmeter and gas discharge display elements.

Circuit Operation

The DVM (digital voltmeter) is designed around a pair of IC's U2330 (DVM Analog) and U2340 (DVM digital). Refer to figure 3-15.

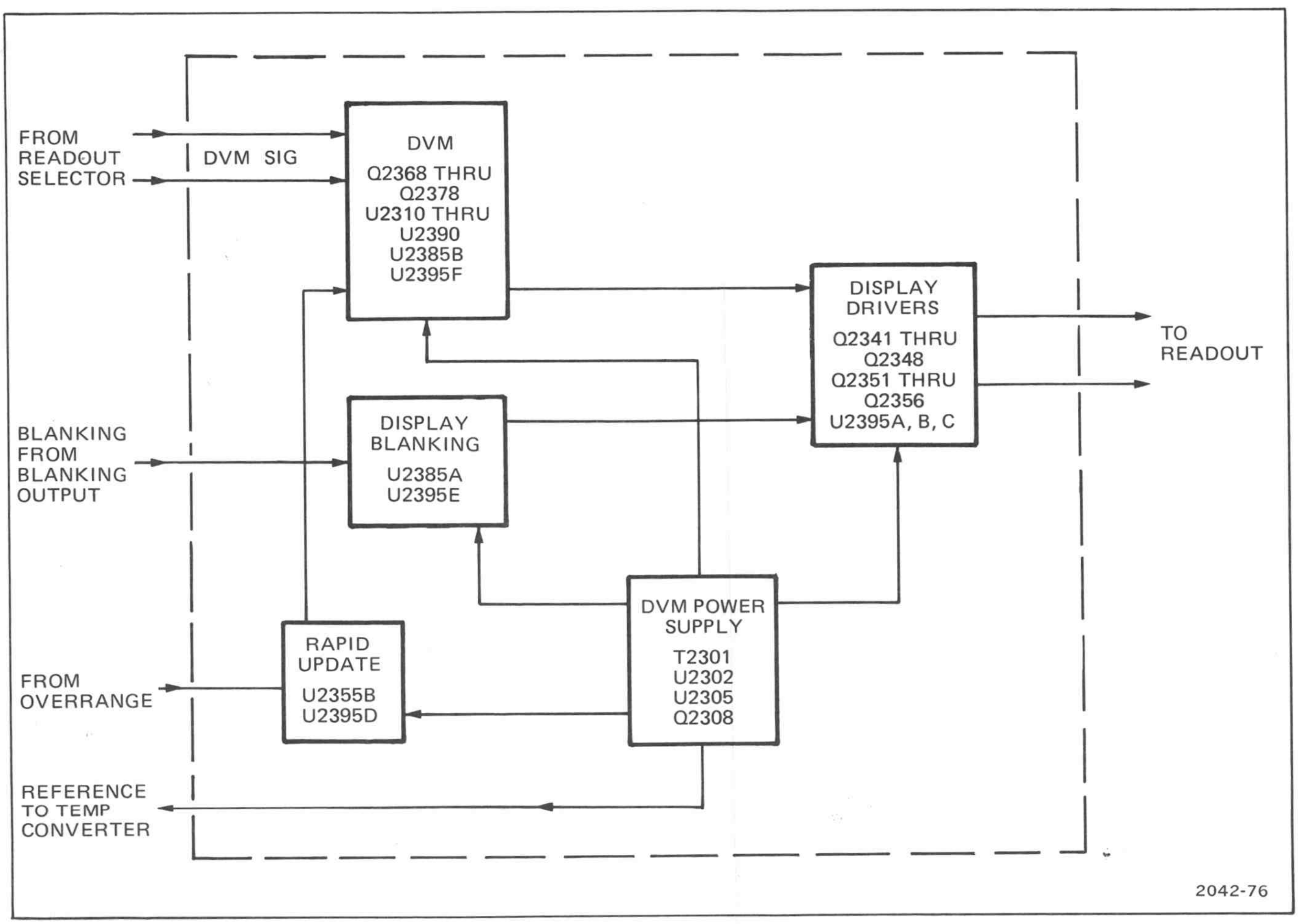


Fig. 3-15. DVM block diagram.

Basically the DVM is an integrator and counter. It uses a dual-slope system that generates a current proportional to the unknown input current. The input voltage causes an integrator circuit to run up linearly (ramp). Then the integrator is switched to internal reference current (polarity opposite that of unknown) that causes the integrator to run back down. See figure 3-16.

The unknown current ramp runs up for exactly 1000 counts, then switches to the reference current and counts back down. To provide ramp runup even though the unknown voltage is zero, a fixed offset current is added to the unknown. To compensate for this added offset current, the down ramp count is delayed by 100 counts (the equivalent of the fixed offset current on the upramp).

The number of counts back down (after the 100-count delay) gives the value of the unknown current, and therefore the unknown voltage.

The remaining circuits include the Decoder-Driver, two clocks (sample and display), input Polarity Detector, input Polarity Selector, input Polarity Switch, leading zero suppression, display blanking, and several power supplies, including a reference supply for the analog IC and the Temperature Converter (on diagram 7).

POLARITY SWITCHING. Polarity switching provides the correct signal polarity into the DVM Analog IC.

The Polarity Switch consists of U2335A, B, C, and D, and a differential-input, single-ended-output amplifier. These switches are controlled via Q2367 and Q2378, which are level shifting inverters. The level is shifted because of the different logic levels of U2335 (+ and −7 volts) and U2375B (+5 volts and ground).

U2335 is a double-pole-double-throw switch that feeds the differential amplifier input. The amplifier, U2310-U2315 is an impedance interface between voltage divider (R1070-R1072, via U1060C on diagram 6), and the low-impedance input to U2320.

U2375, Polarity Selector, controls the input-polarity switches. The required polarity (always positive on pin 1 of U2330) is determined by a number of devices that will be discussed later.

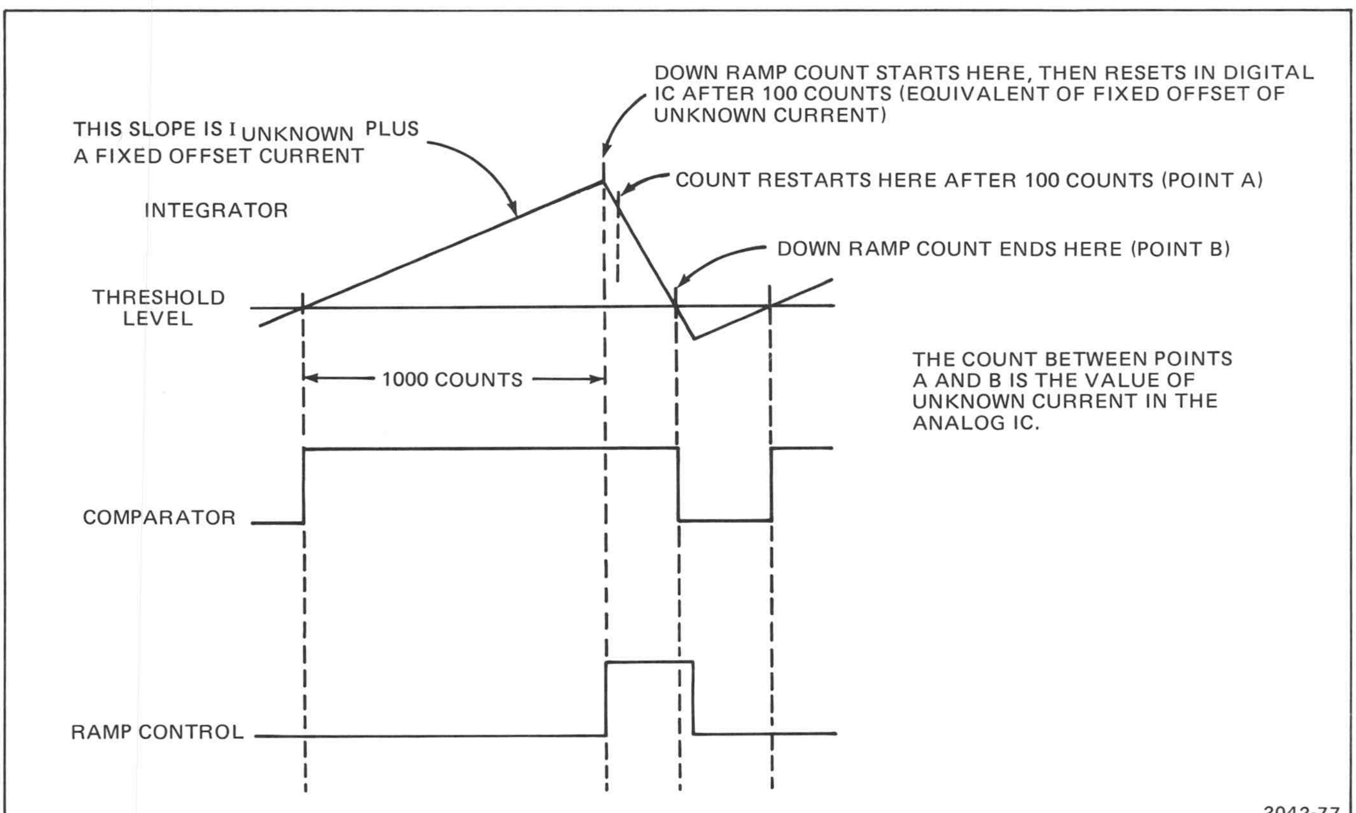


Fig. 3-16. Basic dual-slope A/D converter waveforms.

Pin 7 of U2330 is the output of the dual-slope integrator. When a sampling cycle starts, pin 7 rises linearly (ramp). The unknown input voltage controls a current source that determines the current (including the fixed offset current) into the integrating capacitor C2336.

The ramp runs up for exactly 1000 cycles (determined in the DVM Digital IC U2340). When the count has reached 1000 clock cycles for the up-ramp duration, the ramp control switches, pin 7 of U2340 goes HI, pin 8 of U2335B goes HI, and pin 10 of U2330 (Ramp Control) goes HI immediately. The HI on pin 10 of U2330 switches the integrating circuit to the reference-current source (opposite polarity) and the ramp starts down.

When the down ramp reaches the threshold level the count stops but the ramp continues below the threshold level. During this time the count is transferred to the output multiplexer circuit within U2340. A number of things happen in the IC, including count reset. Ramp Control is also switched back to provide a LO on pin 10 of U2330, to start another ramp up.

If the input polarity to the DVM Analog IC is incorrect (negative), the external 100-Count Delay (U2345) does not expire by the time the Comp Out of the analog IC goes LO. The down ramp has crossed the threshold level before the 100-count delay has expired (either in the digital IC or the external 100-Count Delay).

Therefore, U2358B prevents the count in U2340 from stopping by holding pin 5 of U2340 HI. This ensures that the 100-count delay on the down ramp is complete in the digital IC.

When the external 100-Count Delay expires, pin 5 of U2358B goes LO, and since Comp Out of the analog IC has gone LO prior to this time, pin 4 of U2358B goes HI. The HI at pin 4 of U2358B is inverted by U2395F to a LO at pin 10 of U2340. This LO terminates the count. After a 50 microseconds (C2353-R2353) delay, the HI on pin 10 of U2355B resets the Update flip-flop. Now, Ramp Control, pin 10 of U2330 goes LO, and the ramp again starts up.

U2358D gets its LO on pin 5 from the Q output of flip-flop U2355A.

When the external 100-Count Delay (U2345A-U2345B) completes its count, pin 14 of U2345B goes LO. This transition produces a positive edge from pin 3 of U2358A, which resets U2355A (because data input pin 5 is held LO).

U2355A gets set from U2358D at the beginning of every cycle and reset at the end of the 100-count delay.

When the 100-count delay expires, which is indicated by U2355A being reset, pin 2 ($\overline{Q}$) goes HI. This HI is a clock input to U2365B, and either sets or resets U2365B, depending on the state of the data input, pin 9, which comes in via inverter U2358C, from Comp Out, pin 9 of U2330. If Comp Out is LO when the 100-count delay expires, it means that the IC input sees a negative signal. This condition sets U2365B pin 13 (Q) HI and pin 12 ($\overline{Q}$) LO.

The LO on the $\overline{Q}$ output indicates that the sign is not correct. This LO on $\overline{Q}$ indicates to the Clock Selector (U2375A) that the polarity is not correct, so the Clock Selector remains on Sample Clock (Q is HI).

If, when the 100-count delay expires, Comp Out is HI (meaning that the input signal is positive), the Polarity Detector input is LO, and this causes U2365B to reset. This puts a LO on the Q output and HI on the $\overline{Q}$ output.

The HI on $\overline{Q}$ tells the Clock Selector U2375A that the sign is okay. Clock Selector U2375A changes states, causing the Display Clock to run and the readout displays the information being multiplexed out of U2340.

If the input polarity is negative, the clock cycle counter U2365A allows only one change of sign. After the sign has been changed once, and if on the next sample the sign is still not correct, the Clock Cycle Counter forces the clock to change back to display. The result is a displayed zero, because whenever Comp Out goes LO before the external 100-count delay expires, U2340 is always allowed to run out its 100-count delay and read zero.

Any time there is a negative polarity input that cannot be made positive, no matter how many times the polarity is switched, the circuit is allowed to switch once, per cycle, thus displaying zero. The result is that with zero input to the circuit board, the display will be zero but with the + and — sign displayed alternately on the display (this condition is caused by the DVM ZERO control being set too low).

LEADING ZERO SUPPRESSION. Since multiplexing is from right to left, U2380B is used to store information about digit 3 zero suppression to determine whether to display or suppress a digit 2 zero.

Whether a digit 3 zero gets suppressed or displayed depends on whether digit 4 (the ½ digit) is displayed. The ½-digit information remains on pin 10 of U2340 during the entire display interval.

To determine whether to suppress a digit 2 zero, the system goes through the first multiplexing cycle and blanks the display via U2380A.

There is an interval when pin 4 of U2358A is HI during sampling. This HI sets U2380A, causing display blanking via U2385A. The display remains blanked during the first round of multiplexing.

During this blanking interval, U2380A can either inhibit or toggle to the opposite state. The K input comes from DS1 and since $\overline{\text{DS1}}$ is active LO, U2380A sees LO on both J and K inputs. This is the inhibit mode. So the display remains blanked. When $\overline{\text{DS2}}$ goes LO, $\overline{\text{DS1}}$ goes HI, which is the condition for U2380A reset, but reset cannot occur until the next clock edge at clock input, pin 3. That clock edge does not occur until the end of digit 2. So, on the first multiplexing cycle, digits 1 and 2 remain blanked.

Unblanking now allows digit 3 to be displayed, if it is not zero-suppressed because of the state of the ½ digit.

By the next multiplexing cycle, digit 3 zero suppression is is stored in U2380B to decide whether to blank a digit 2 zero.

The blanking is accomplished through the Ripple Blanking input, pin 5 of U2350.

The ½ digit is on pin 10 of U2340 as soon as the down-ramp count is completed. The ½ digit information goes to pin 4 of U2382A. Also in U2382A are decimal point 3 and 4 information (whether decimal 3 or 4 is lit; pins 2 and 3 of U2382A). Digit select 3 information comes in on pin 5 of U2372A.

When all four inputs to U2382A are LO, and if the ABCD code is 0 in the Decoder/Driver, then the Ripple Blanking circuit blanks all of the segments of the digit 3 display even though the anode has been selected.

If $\overline{\text{DS2}}$ (pin 9 of U2382B), DP2 (pins 11 and 12 of U2382B) and $\overline{\text{Q}}$ of U2380B (pin 10 of U2382B) are all LO, and the ABCD code is 0, the Ripple Blanking circuit blanks all of the segments at the digit 2 display, even though the anode has been selected.

UPDATE FLIP-FLIP. The Update FF (flip-flop) receives logic from several sources to start the ramp up (U2330), start the ramp down, and to provide logic to the external 100-Count Delay FF, the Clock Cycle Counter, and the Clock Selector.

In normal operation the Update FF U2355 gets reset once per second, from the DVM Digital IC.

Rapid update, coming from pin 7 of P2300, provides a LO at pin 9 of U2395D. Therefore, pin 11 of U2355B goes HI. Since U2355B data line is HI at all times, the positive-going edge on pin 11 (clock) sets U2355, causing the ramp control to start the run down.

When in the slow clock (Display) mode, the DVM IC pair is still operating as if it were taking a sample. However, because the clock is so slow, the ramp runs up rapidly to saturation, and remains there.

When a rapid update signal arrives to set U2355B, the ramp control input to U2330 switches and the ramp starts back down. As soon as the down ramp reaches the comparison level, the system is forced to go through a cycle of sample clock, and then reverts back to slow (Display) clock. The rapid update occurs every 200 milliseconds whenever rapid update is required.

The external 100-Count Delay FF (U2355A) gets set by U2358D when pins 12 and 13 go LO during the up-ramp interval. The external 100-Count Delay resets U2355A at the end of 100 counts.

ANODE DRIVERS. The display anodes AD1, AD2, AD3, and AD4 are driven from the Anode Driver circuits, Q2341-Q2345, Q2342-Q2346, Q2343-Q2347, and Q2344-Q2348.

The Anode Drivers, except AD4, are driven by the $\overline{\text{DS}}$ outputs of the DVM Digital IC, U2340. The Anode Driver circuits are identical (except AD4) so only one is described.

When $\overline{\text{DS1}}$, pin 2 of U2340, goes LO, Q2341 turns on, pulling its collector down far enough to cause Q2345 to saturate. When Q2345 saturates, AD1 (pin 1 of P2355) goes to about +165 volts, to drive the gas discharge display anode to +165 volts.

Since Q2344 emitter return is grounded, Q2344 conducts and Q2348 is saturated at all times except when all digits are blanked. This occurs when the bases of Q2341, Q2342,

Q2343, and Q2344 (bases common) are pulled low by U2385A during any blanking interval (when all digits get turned off).

DECODER/DRIVER. The Decoder/Driver (U2350) converts the binary-coded-decimal (BCD) information from the DVM Digital IC to the form required to drive the cathode segments of the 7-segment gas-discharge display.

When the segments are not turned on by a signal from the Decoder/Driver, the segments are set at about +75 volts by the one-megohm resistors in U2352 (U2352J through P). When turned on, the segment drivers pull toward ground and current is controlled in the Decoder/Driver.

The binary code on A, B, C, and D determines which segments are turned on.

SIGN ENABLE LOGIC. When $\overline{\text{SIGN ENABLE}}$ is LO (from Readout Selector logic) U2390A and B are enabled so that the sign information from the Polarity Selector (pin 15 of U2375B) activates one of the Sign Drivers, Q2351 or Q2352.

SIGN, DECIMAL, AND ½-DIGIT DRIVERS. Transistors Q2351 through Q2356 are cathode-current drivers for the + and – signs, the decimal points, and the ½-digit (1). When the base of one of the driver transistors is pulled HI (to +5 volts), the emitter resistor to ground sets the collector current, thus turning on the desired display cathode at a controlled current level.

Diodes CR2373, CR2383, CR2387, CR2388, CR2397, and CR2399 prevent transistor saturation during digit-anode blanking periods. This keeps emitter current (diverted to the transistor base if the transistor is saturated) from affecting the logic lines that drive the transistor bases.

The decimal-point drivers Q2354, Q2355, and Q2356 get their signals from the Readout Selector switching circuitry via P2300 and U2395A, B, and C.

The ½-digit (1) driver Q2353 gets its signal from pin 10 of U2340.

CLOCK CIRCUITS. There are two clocks in the digital voltmeter: a Sample Clock that runs only when a sample of the count is being taken; and a Display Clock that runs at a much lower frequency to display the count that has beem sampled.

The Display Clock uses an IC timer, U2360 to produce a 1 kilohertz asymmetrical rectangular pulse. Pin 4 of U2360 is used as a gate. When pin 4 is HI, the clock runs; when pin 4 is LO, the clock is off.

The Sample Clock, consisting of Q2368, Q2370, and Q2373, runs at 250 kilohertz, with Q2368 used as a gate. A HI on Q2368 base turns the clock on. The clock receives its logic from the Clock Selector flip-flop, U2375A.

Q2370 and Q2373 form an oscillator. Assuming that Q2373 is turned on, Q2370 is off with Q2373 base at about +5 volts. C2378 charges through R2377 toward –12 volts. When the junction of R2377-C2378 reaches –0.6 volts, Q2370 turns on, pulling Q2373 base down and Q2373 starts to turn off. The regenerative action causes Q2370 to saturate. Q2373 now turns off. C2378 now charges (in the opposite direction) via R2379 toward –12 volts. The junction of C2378-R2379 pulls Q2373 emitter down until Q2373 turns on again. Q2370 now turns off and a new cycle starts.

+5 VOLT REGULATOR. The +5 volt supply is derived from the +7 volt supply by error amplifier (U2305) and pass transistor (Q2308), to provide +5 volts for most of the digital devices in the digital voltmeter.

SAMPLE SIGNAL OUTPUT. Transistor Q2375 provides a signal via pin 4 of P2300 to the Readout Selector switching circuit to operate the Systolic/Diastolic selector.

GAS DISCHARGE DISPLAY POWER SUPPLY. The Gas Readout Supply uses transformer T2301 to provide –90, +75, and +165 volts to the gas-discharge readout display.

T2301 primary is supplied from a voltage (28 volts peak-to-peak) picked off transformer T801 in the main power supply.

The secondary (T2301) voltages (–90 and +75) are rectified and filtered in the conventional manner. The +165 volts is produced by a voltage doubler circuit (CR2395-C2390-C2393-CR2393).

INTERDIGIT BLANKING. The Display Clock signal also provides interdigit display blanking.

When switching from one digit to the next in the same envelope, the display must be blanked briefly to permit deionization of the gas in the readout. This blanking prevents partially lit segments and streamers (blue glow) between digits.

During each Display Clock period, pin 11 of U2390D is HI for 250 microseconds and LO for 750 microseconds of the 1 millisecond clock period. This signal from pin 11 of U2390D is fed to pin 2 of U2380A, which turns off the anode drivers for 250 microseconds at the beginning of each display clock cycle.

REFERENCE VOLTAGE SUPPLY. The Reference Voltage Supply, provided by VR2302-U2302 and associated components, supplies a very stable reference voltage to U2330 (DVM Analog IC) and to the Temperature Converter circuit.

The voltage is set by VR2302 and feedback amplifier U2302 to provide a low-impedance output. R2301 sets VR2302 current, and R2303 supplies some current from +12 volts to VR2302 in order to reduce the load on U2302 output.

MAINTENANCE

PREVENTIVE MAINTENANCE

ROUTINE MAINTENANCE SCHEDULE

Preventive maintenance consists of cleaning, visual inspection, etc. The severity of the environment to which the instrument is subjected will determine the frequency of maintenance. Table 4-1 is a suggested routine preventive-maintenance schedule for monitors in continuous use. Obvious defects should be corrected immediately.

TABLE 4-1
Routine Maintenance Schedule

	1 Month	6 Months
Clean exterior		as required
Inspect accessory cables and wires	X	
Inspect power cord and plug	X	
Perform isolation leakage check		X
Adjust	X	

OPERATOR INFORMATION

Preventive maintenance to be performed by an operator consists of external cleaning and visual inspection. The following information, also included in the 414 Operator's Manual, is intended for use by both operator and service personnel.

Exterior Cleaning

Clean the exterior surfaces of the monitor with a cloth or swab dampened with a warm water and mild soap solution. Do not permit fluids to flow behind the knobs and push buttons or into the connectors.

CAUTION

Avoid the use of chemical cleaning agents that might damage the plastics used in this monitor.

Inspection

Inspect all accessory cables, wires, etc. Pay careful attention to the points that are subjected to repeated flexing. Breakage may have begun at these points. Replace frayed or otherwise damaged cables.

Inspect the power cord and plug for damage. Repair or replacement should be performed only by qualified personnel.

CAUTION

Monitors that have been dropped or otherwise abused, should be checked by qualified service personnel to verify all safety features.

Calibration & Safety

Qualified service personnel should check the calibration of the monitor at least every two years. It is also recommended that the electrical safety features be inspected and ECG patient-circuit leakage current be measured every six months.

WARNING

Electric shock hazard exists when the monitor covers are removed. Refer servicing to qualified personnel.

SERVICE INFORMATION

Preventive maintenance to be performed by service personnel consists of external cleaning (see Operator Information above), visual inspection, adjustment, and ECG patient-circuit leakage checks.

WARNING

Electric shock hazard exists when monitor is operated with covers removed. Avoid touching exposed connections or components which might be elevated from ground (e.g., some metal-cased transistors).

All ac line-voltage connections are covered and located on the rear panel. Some exposed voltages are, + and −35 V in the vertical amplifier circuit and −50, +175, and +3400 V in the crt circuit.

Disconnect monitor from ac power source and unplug battery-pack plug (P711) before cleaning interior of monitor or replacing components.

Visual Inspection

In addition to checking external cables and wires as discussed under Operator Information, the 414 interior should be inspected occasionally. Check for such defects as broken connections, improperly seated semiconductors, damaged circuit boards, and heat-damaged parts.

The method for correcting most visible defects is obvious. However, be particularly careful if heat-damaged components are found because overheating usually indicates other trouble in the instrument. It is important to correct the cause of overheating to prevent recurrance of the damage.

Adjustment

Monitor adjustment should be checked at least every two years or 2000 hours. Certain adjustments may be necessary following component replacement as indicated in the Component Replacement portion of this section. Adjustment procedures are located in section 5.

ECG Leakage Check

A leakage check should be made at least every six months or whenever the monitor has been dropped or otherwise abused. Also, check leakage after any repairs.

This check determines the amount of leakage current that could be present between the patient and the ECG circuit of the monitor under either of the following abnormal conditions: (1) monitor is properly grounded and patient is at 120 V ac, 60 Hz, or (2) monitor is not grounded, case is connected to 120 V ac, 60 Hz and patient is grounded.

Test Equipment Required

Use an instrument such as the Model 431 Safety Analyzer, manufactured by Neutrodyne-Dempsey Inc., P.O. Box 1925, Carson City, Nevada.

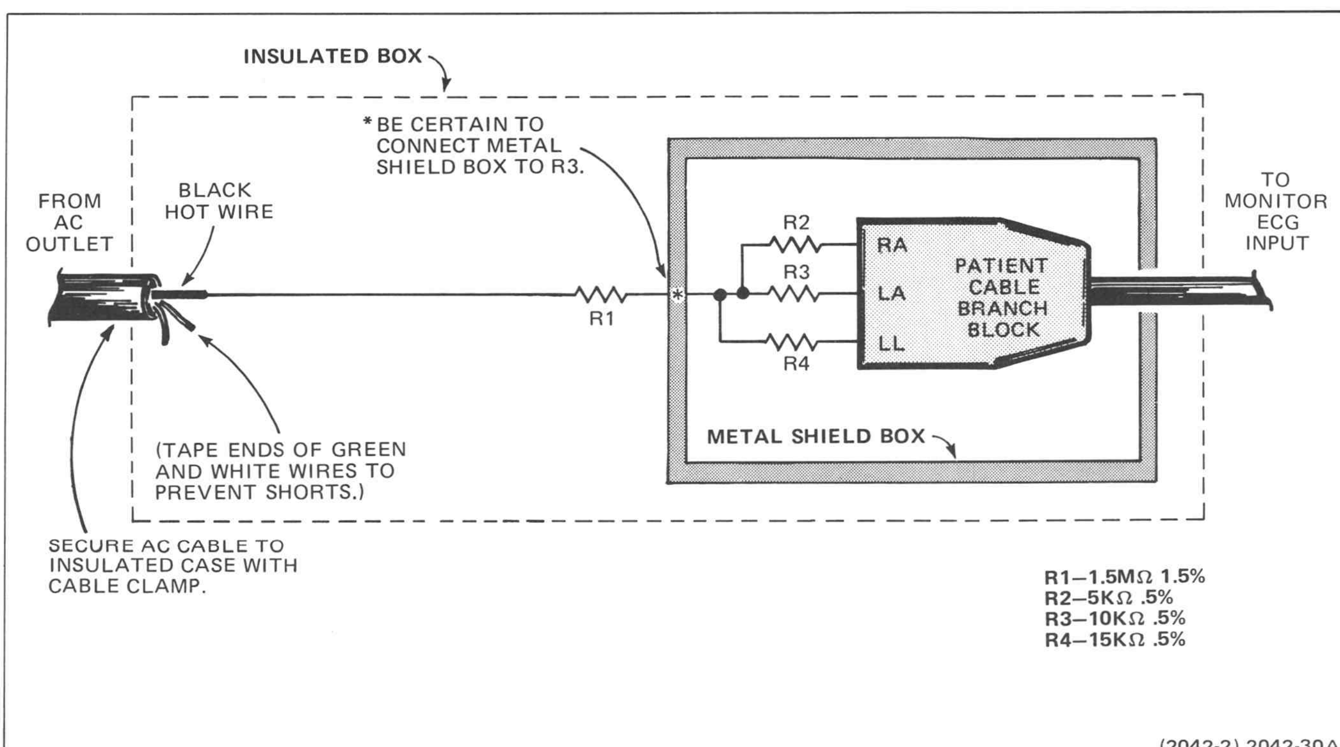


Fig. 4-1. CMRR-Leakage test fixture.

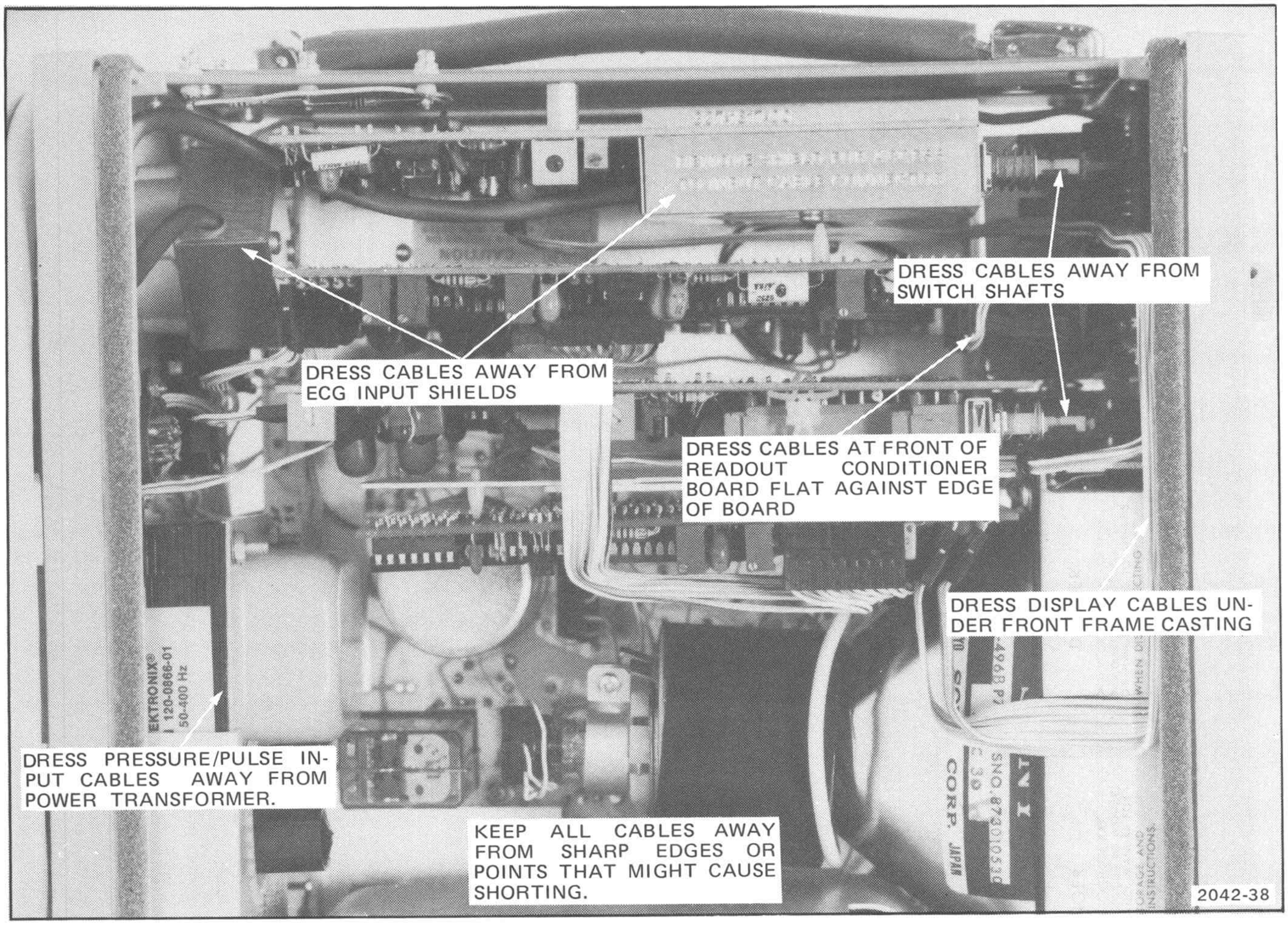


Fig. 4-2. Proper cable dress.

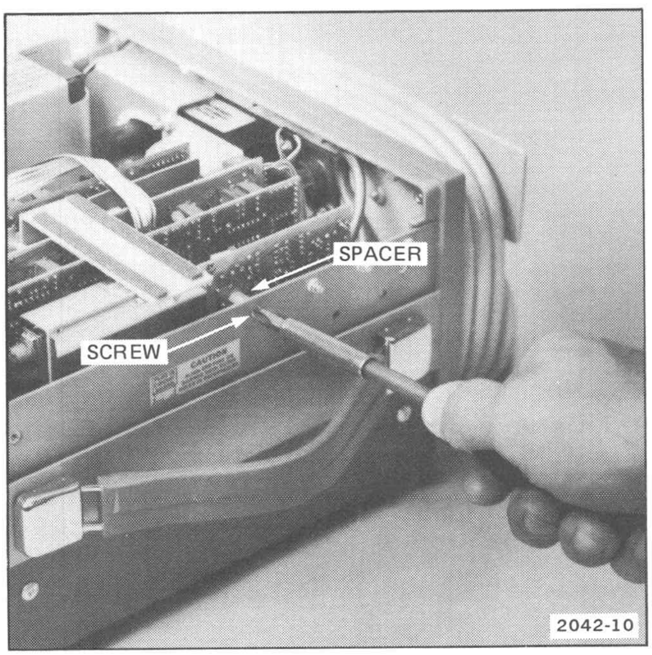


Fig. 4-3. ECG board securing.

Leakage Check Procedure

a. Disconnect monitor from ac power source.

b. Remove top and bottom covers.

c. CHECK—All plug-in circuit boards are pushed firmly into their mating receptacles.

d. CHECK—All cables are plugged into their mating pins and that they are dressed away from ECG shield, input connector shield and pushbutton switch shafts (see Fig. 4-2).

e. CHECK—Screw and spacer securing ECG circuit board are tight (see Fig. 4-3).

f. CHECK—Plastic board retainer is installed and properly seated at top of circuit boards (see Fig. 4-6).

g. Replace top and bottom covers. Leakage check is valid only with covers installed.

h. Check ECG-leakage current using procedure supplied by the Safety Analyzer manufacturer.

TROUBLESHOOTING AIDS

SERVICING EXTENDER SET

By using the Servicing Extender set, any of the plug-in circuit boards can be raised above the others for troubleshooting purposes. The Tektronix Part Number is 020-0188-00.

SCHEMATIC DIAGRAMS

Complete circuit diagrams are given on foldout pages in the Diagrams section. The portions of the circuit mounted on circuit boards are enclosed with heavy lines. The component number and electrical value of each component in this instrument are shown on the diagrams (see the first page of the Diagrams section for definition of the reference designators used to identify components). Each main circuit is assigned a series of component numbers to assist in identifying their circuit location. Important voltages and waveforms are also shown on the diagrams. The physical locations of the waveform test points are shown on the circuit-board illustrations.

CIRCUIT BOARD ILLUSTRATIONS

In conjunction with each circuit diagram is a circuit board illustration. These are located on the back of the pull-out page opposite the associated circuit diagram. Each circuit component shown on the circuit diagram is identified on the circuit board illustration by its circuit number. Circuit number locations are identified with a grid-index system.

COMPONENT VALUE IDENTIFICATION

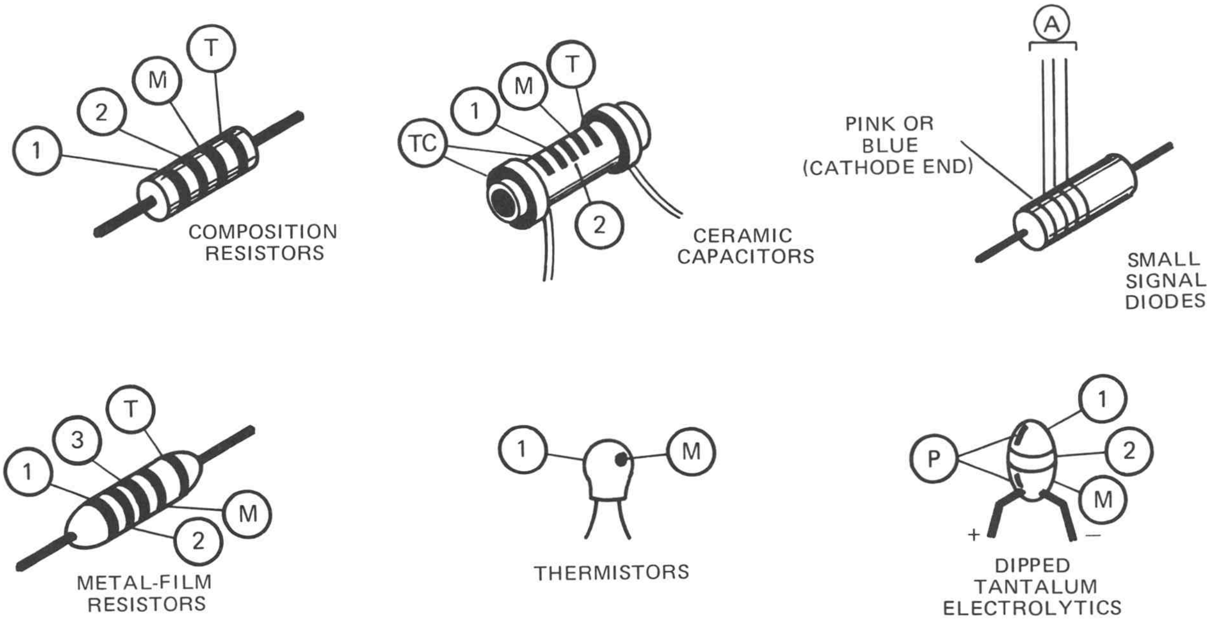
Values of capacitors, diodes and resistors used in this instrument are identified by direct numerical values or by a color-code scheme. Figure 4-4 shows the color-code and numerical-value schemes used.

SEMICONDUCTOR LEAD CONFIGURATIONS

Typical semiconductor lead configurations are shown in Figure 4-5. Before handling semiconductors or boards containing semiconductors, see the special handling note in this section under Component Removal and Replacement, Semiconductors.

CABLING DIAGRAM

The Cabling Diagram pull-out page in the Diagrams section shows the cable plug numbers, the number of conductors in the cable, and the boards to which they connect.



(A) COLORS IDENTIFY SIGNIFICANT DIGITS IN TEKTRONIX PART NUMBER (E.G. BROWN, GRAY, GREEN STRIPES INDICATE PART NUMBER 152-0185-00)

(1) (2) and (3) 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.

(M) MULTIPLIER (T) TOLERANCE;

(TC) TEMPERATURE COEFFICIENT.

(B) TOLERANCE; F=±1%, J=5%, K=10%, M=20%

(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;

(P) POLARITY AND VOLTAGE RATING

COLOR	SIGNIFICANT FIGURES	RESISTORS (Ω)		CAPACITORS (pF)			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE Over 10 pF	TOLERANCE Under 10 pF	
BLACK	0	1	———	1	±20%	±2 pF	4 VDC
BROWN	1	10	±1%	10	±1%	±0.1 pF	6 VDC
RED	2	10^2 or 100	±2%	10^2 or 100	±2%	———	10 VDC
ORANGE	3	10^3 or 1 K	±3%	10^3 or 1000	±3%	———	15 VDC
YELLOW	4	10^4 or 10 K	±4%	10^4 or 10,000	+100% −9%	———	20 VDC
GREEN	5	10^5 or 100 K	±½%	10^5 or 100,000	±5%	±0.5 pF	25 VDC
BLUE	6	10^6 or 1 M	±¼%	10^6 or 1,000,000	———	———	35 VDC
VIOLET	7	———	±1/10%	———	———	———	50 VDC
GRAY	8	———	———	10^{-2} or 0.01	+80% −20%	±0.25 pF	———
WHITE	9	———	———	10^{-1} or 0.1	±10%	±1 pF	3 VDC
GOLD	–	10^{-1} or 0.1	±5%	———	———	———	———
SILVER	–	10^{-2} or 0.01	±10%	———	———	———	———
NONE	–	———	±20%	———	±10%	±1 pF	———

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Fig. 4-4. Component value identification.

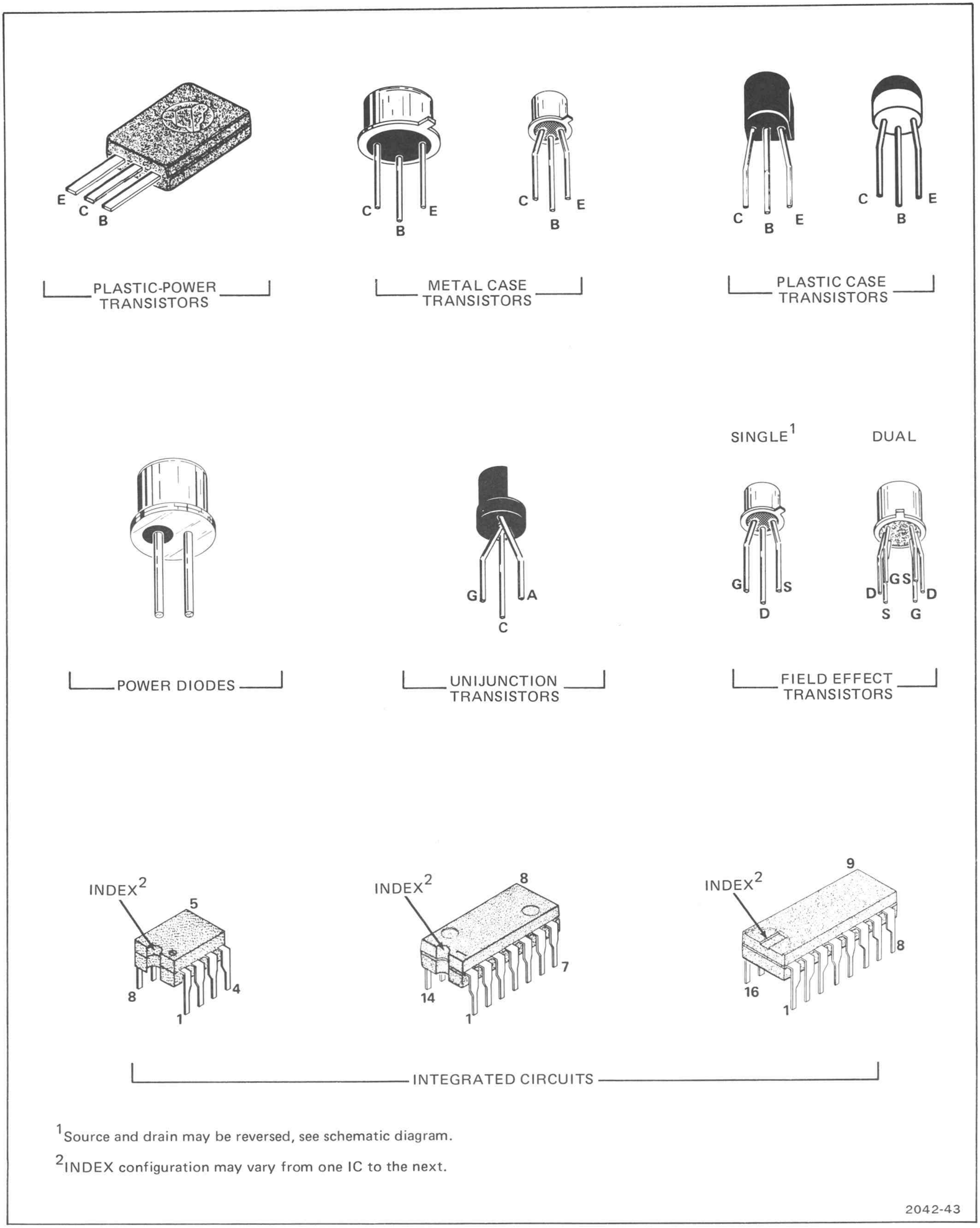


Fig. 4-5. Semiconductor lead configurations.

CORRECTIVE MAINTENANCE

SERVICE RECORD

It is advisable to keep a detailed service record, since the monitor and its accessories are involved with patient care and safety. Include information such as monitor type and serial number, failures, symptoms, routine maintenance performed and the date.

SOLDERING INFORMATION

WARNING

Disconnect the monitor from the power source and unplug the battery pack plug (P711) before soldering.

Use ordinary 60/40 solder and a 15 watt pencil-type soldering iron for most soldering in the monitor. If higher-wattage soldering irons are used to remove large surface components, be careful not to apply so much heat that the etched circuit wiring separates from the base material. Excessive heat can also cause serious damage to multilayer circuit boards.

READJUSTMENT AFTER REPAIR

After any electrical component has been replaced, check the adjustment of that particular circuit and other closely related circuits. Check the adjustment of the entire monitor after working on the power supply. ECG patient-circuit leakage must be checked following any repair or readjustment.

OBTAINING REPLACEMENT PARTS

Standard Parts

All electrical and mechanical part replacements for the monitor can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE

Physical size and shape of a component may affect instrument performance. Always use direct-replacement components, unless it is known that a substitute will not degrade instrument performance.

Special Parts

In addition to the standard electronic components, some special components are used in the 414. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special components are indicated in the parts list by the Tektronix, Inc. manufacturer code (80009) listed in the Mfr. Code column. Most of the mechanical parts used in this instrument, except miscellaneous hardware, have been manufactured by Tektronix, Inc. Order all special parts directly from your Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., it is important that all of the following information be included in the order to ensure receiving the proper parts.

1. Instrument type (include mod or option numbers).
2. Instrument serial number.
3. The complete description line from the parts list (Circuit No., Tektronix Part No., Serial/Model No., etc.).

COMPONENT REMOVAL AND REPLACEMENT

WARNING

Disconnect the monitor from the power source and unplug the battery pack plug (P711) before replacing components.

Cabinet

To remove the top cover, remove the two screws on each side, lift up the left side of the cover, then make sure it has cleared the ECG LEAD CHECK terminals and remove the cover from the monitor.

To remove the bottom cover, remove the two screws on each side and pull the cover straight off.

NOTE

Be sure board retainer clip is in place before replacing top cover. See Figure 4-9.

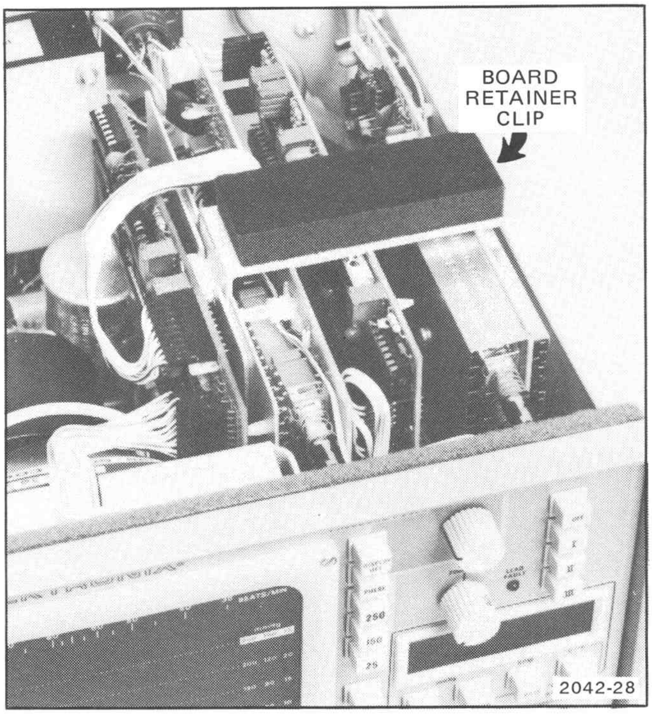


Fig. 4-6. Board retainer clip installation.

Instrument Disassembly

Use the exploded drawings at the rear of this manual as a guide for disassembly. Observe all cautions and warnings found in this section and on the instrument. Figure 4-6 shows locations of the circuit board assemblies.

Push Buttons

Remove push buttons by pulling straight off with fingers or with pliers that are protected with cloth or tape. Install push buttons by pressing them onto the shaft extensions. Push buttons should be removed before removing circuit boards to prevent damage to switch shafts.

Batteries

Before replacing the batteries, read the Battery Operation and Condition information in the Operating Information section.

The battery pack consists of four D or F size, 1.25 V nickel-cadmium (NiCd) cells, which are mounted inside of a metal case and fastened to the left side rail with two #4-40 flat-head screws. The battery power plug (P711) is connected to the Main Board.

CAUTION

The nickel-cadmium cells are capable of delivering a high current. Do not short circuit the cells, since this can cause the wire insulation to melt.

1. Unplug the battery pack plug (P711) from the Main Board.

2. Remove the two screws holding the battery pack to the left side rail and lift it out of the monitor.

3. Remove the four nuts holding the battery pack together.

NOTE

Do not replace individual cells unless the batteries are relatively new (e.g., less than one year). Replace the cells only with the type specified. Other types may not function properly or may be a hazard to the monitor and personnel. Operating time and/or high-temperature performance may be degraded.

Interconnecting Cables and Terminal Connectors

Interconnecting cable assemblies used in the 414 consist of multiple-conductor cable with machine-installed terminal connectors, mounted in plastic holders.

The plastic holders, except on the battery cable, can be replaced easily. However if the cable is defective, such as a wire broken loose from the terminal connector, it is often advisable to replace the complete cable assembly.

If the terminal connectors come loose from the plastic holder, they can be reinstalled as shown in Figure 4-7. When reinstalling connectors on board pins, be sure to match the triangle on the connector holder with the triangle on the circuit board for proper orientation.

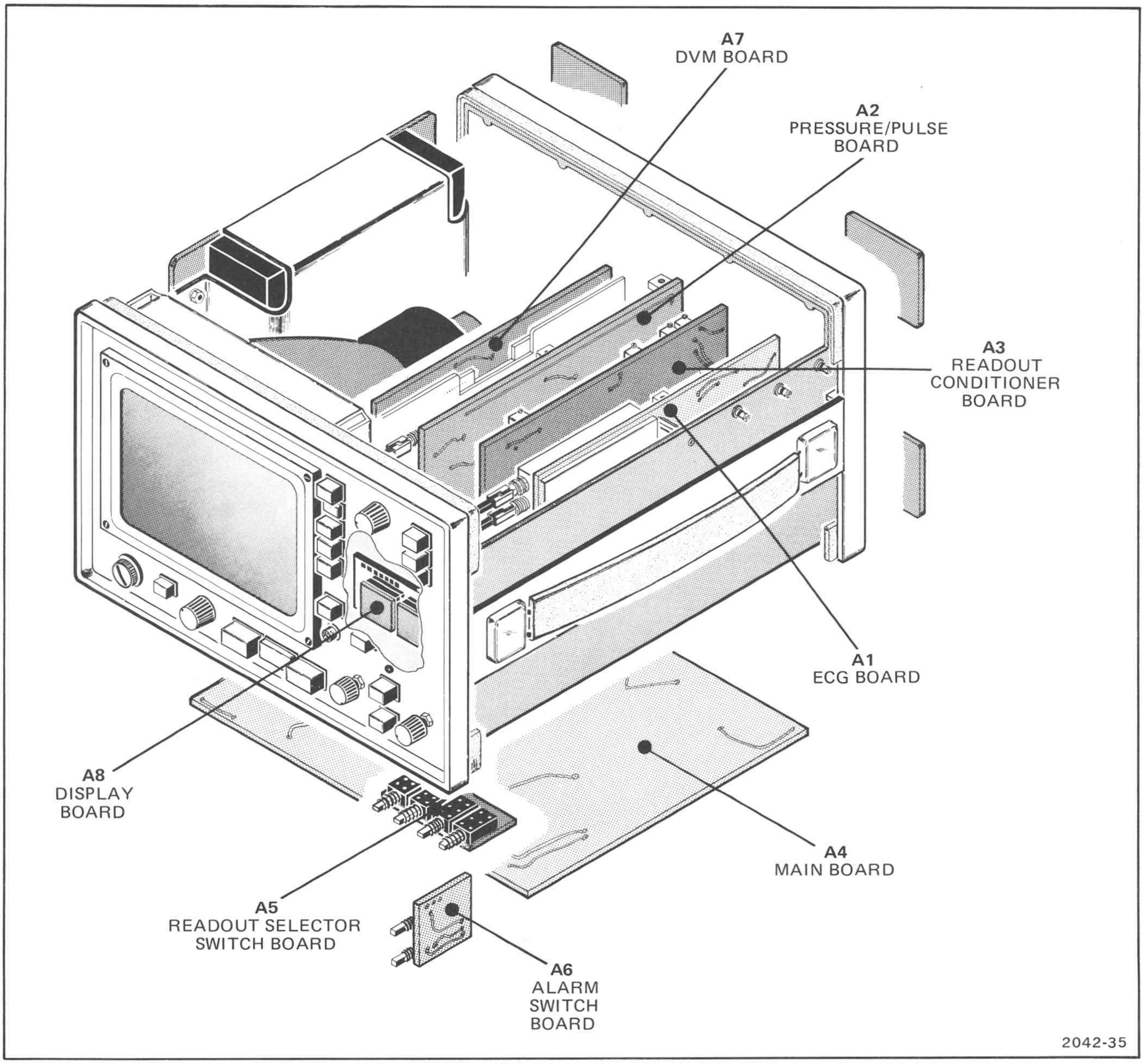


Fig. 4-7. Circuit board locations.

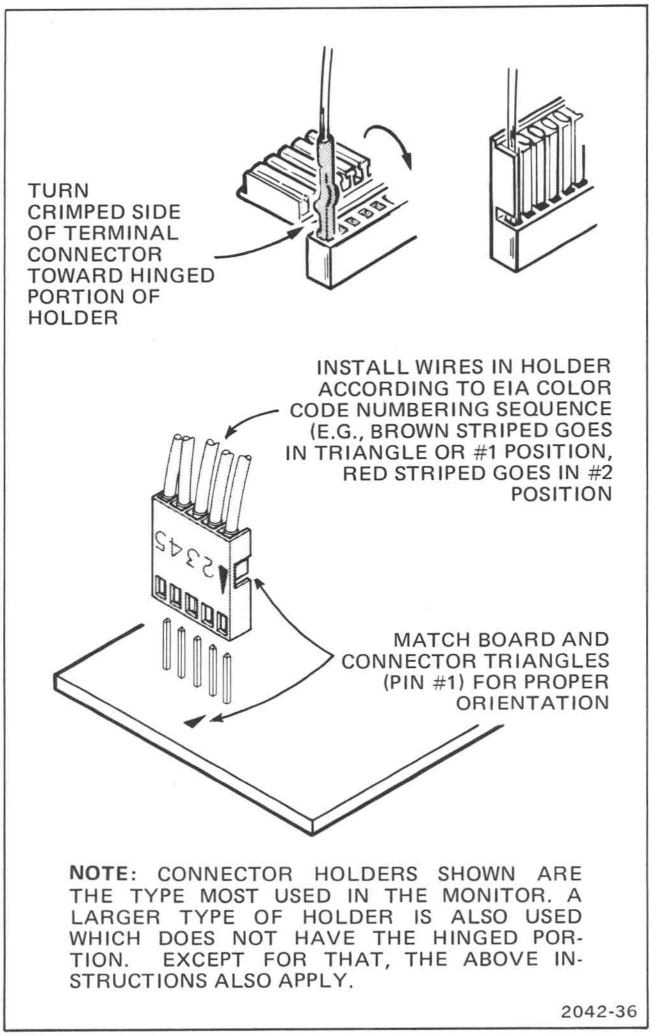


Fig. 4-8. Terminal connectors.

Semiconductors

CAUTION

See semiconductor caution note on next page.

Semiconductors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of this instrument. When semiconductors are replaced, check the operation of the part of the instrument which may be affected.

CAUTION

To avoid component damage, power must be turned off before removing or replacing semiconductors.

Replacement devices should be of the original type or a direct replacement. Figure 4-5 shows the lead configurations of the semiconductor devices used in this instrument. When replacing, check the manufacturer's basing diagram for correct basing. Semiconductors that have heat radiators use silicone grease to increase heat transfer. Replace the silicone grease when replacing these semiconductors.

WARNING

Handle silicone grease with care. Avoid getting the silicone grease in eyes. Wash hands thoroughly after use.

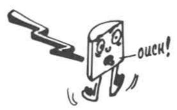
An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part 003-0619-00. If an extracting tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. To prevent damage to the pins, avoid having one end of the integrated circuit disengage from the socket before the other.

Circuit-Board Pins

A circuit-board-pin replacement kit, for the type shown in Figure 4-9, is available from Tektronix, Inc. Kit includes necessary tools, instructions, and replacement pins. Order Tektronix Part 040-0542-00. Replacement of circuit-board pins on multilayer boards is not recommended; refer such repais to your local Tektronix Field Office or representative.

CAUTION

Only experienced service personnel should replace circuit-board pins on multi-layer boards. Therefore, refer repairs of the Readout Conditioner Board to your local Tektronix Field Office or representative.



—CAUTION—



SEMICONDUCTORS SUBJECT TO
STATIC-DISCHARGE DAMAGE
(SPECIAL HANDLING REQUIRED)

MANY SEMICONDUCTORS USED IN THIS INSTRUMENT, ESPECIALLY METAL-OXIDE-SEMICONDUCTOR (MOS) TYPES, CAN BE DAMAGED BY STATIC DISCHARGE, IF NOT HANDLED PROPERLY.

STATIC-DISCHARGE DAMAGE IS USUALLY NOT CATASTROPHIC AND THEREFORE MAY NOT BE IMMEDIATELY APPARENT. IT USUALLY SHOWS UP AS A SUBTLE "WEAKENING" OF SEMICONDUCTOR CHARACTERISTICS.

STATIC-DISCHARGE DAMAGE CAN BE SIGNIFICANTLY REDUCED BY FOLLOWING THE RULES BELOW.

RECOMMENDED HANDLING RULES

Storing and Transporting

Don't *remove semiconductors or boards containing semiconductors from original antistatic container until needed.*

Don't *store or transport semiconductors or boards containing semiconductors in plastic containers, styrofoam or other nonconductive material, unless specifically treated for antistatic qualities.*

Installing

Do *discharge any static charge you may have accumulated before handling semiconductors or boards containing semiconductors.*

Do *use grounded soldering iron and test equipment.*

Do *turn the instrument power off before removing or inserting semiconductors.*

Do *use a static free surface when working on boards or instruments containing semiconductors. (A sheet of card board should be placed over non-antistatic treated plastic work surfaces.)*

Don't *slide semiconductors or boards containing semiconductors across any surface.*

Don't *touch semiconductor leads unless necessary.*

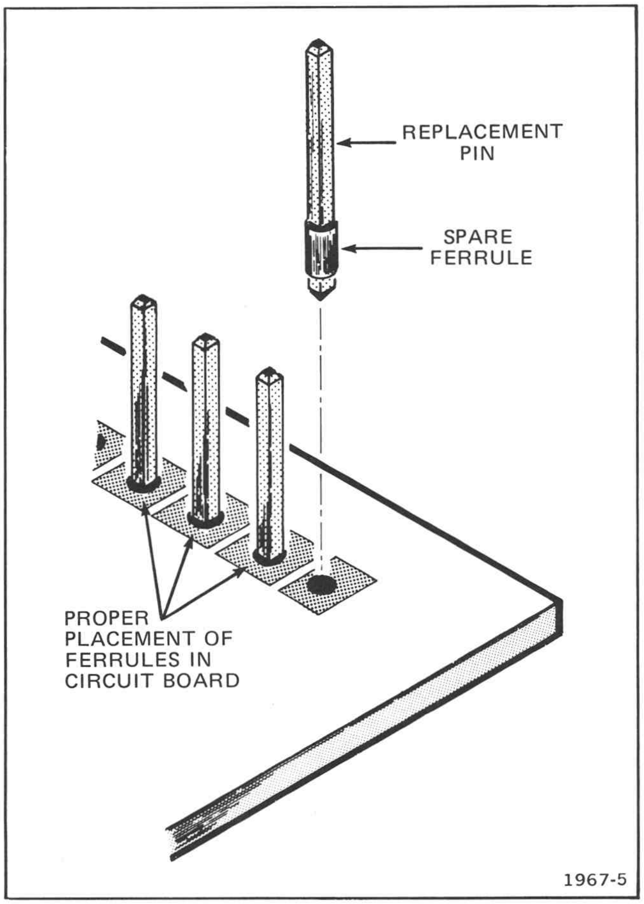


Fig. 4-9. Exploded view of circuit board pin and ferrule.

To replace a damaged pin which is mounted on a single-layer circuit board, unsolder the damaged pin and pull it from the board with a pair of pliers. Leave the ferrule (see Figure 4-9) in the hole, if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing wick and a scribe. Then press the replacement pin with attached spare ferrule into the hole. Position the replacement pin in the same manner as the old pin. Solder the pin to the circuit board on each side of the board. If the old pin was bent at an angle to mate with the cable plug, carefully bend the new pin to the same angle.

Front Panel

Remove the cathode-ray tube (crt), bezel and graticule (held with four screws). Remove the 5 knobs (use allen wrench) and the control mounting nuts and washers. Carefully pull the panel away from the front subpanel.

When the front panel is replaced, check the alignment of the knob indexes with the front panel numbers.

Circuit Boards

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers are given in the Replaceable Electrical Parts list for completely wired boards.

CAUTION

To prevent possible damage to monitor, when installing boards, be sure to align end pins on boards with outer holes in receptacles. Also be sure to match triangles on the cable plugs with those on the boards.

Cable dress is important, especially for ECG patient-circuit safety. Before removing circuit boards, study the cable dress and attempt to re-dress the cables similarly after board replacement.

MAIN BOARD. To remove the Main Board, first remove the four attached plug-in boards from the top of the instrument.

The Main Board is held in place with five screws through the board and two screws through the left side rail into the transistor heat sink. The heat sink should be removed with the board.

NOTE

Replacing U662 may change the width of the Retrace Blanking pulse (30 ms nominal, allowable range from 20 ms to 40 ms; measure at U662 pin 4). To re-establish the desired pulse width, change the value of R658 as required (6.2 MΩ nominal value, allowable range from 2.7 MΩ to 22 MΩ).

Replacing Selected Trigger IC U620 may require that the value of R653 be changed to maintain a pulse width between 50 ms and 125 ms at U620 pin 11. Nominal pulse width is 75 ms and the nominal resistance of R653 is 1.8 MΩ. The allowable resistance range for R653 is from 820 kΩ to 3.9 MΩ.

When replacing the Main Board, refer to the Cable Interconnections pull-out page in the Diagrams section. After board replacement, check the adjustment of the entire monitor and check ECG patient-circuit leakage.

ECG BOARD. To remove board:

1. Pull off board retainer clip.
2. Remove screw holding board to right-hand rail. See Figure 4-3.
3. Pull off ECG push buttons.
4. Pull board straight away from Main Board to unplug.
5. Tip board and remove it from monitor.
6. Remove screw from input circuit shield. Slide shield down cable.

7. Unplug both cable plugs from board.

8. If replacement board is to be installed, transfer push button switch-shaft extensions to new board. See note.

NOTE

Switch shaft extensions are easily broken during removal unless proper method is used. Carefully insert a sharp pointed tool, such as an awl, between end of shaft and extension. This should force extension straight off shaft.

To install board: (See Cable Interconnections pull-out page in diagrams section)

1. Connect ECG input cable plug (P106) to board. Match triangle on plug with the one on board.

2. Install shield as shown in Figure 4-10.

3. Connect plug P200. Match triangles.

4. Plug board into interface receptacles on Main Board. Tip as necessary to install.

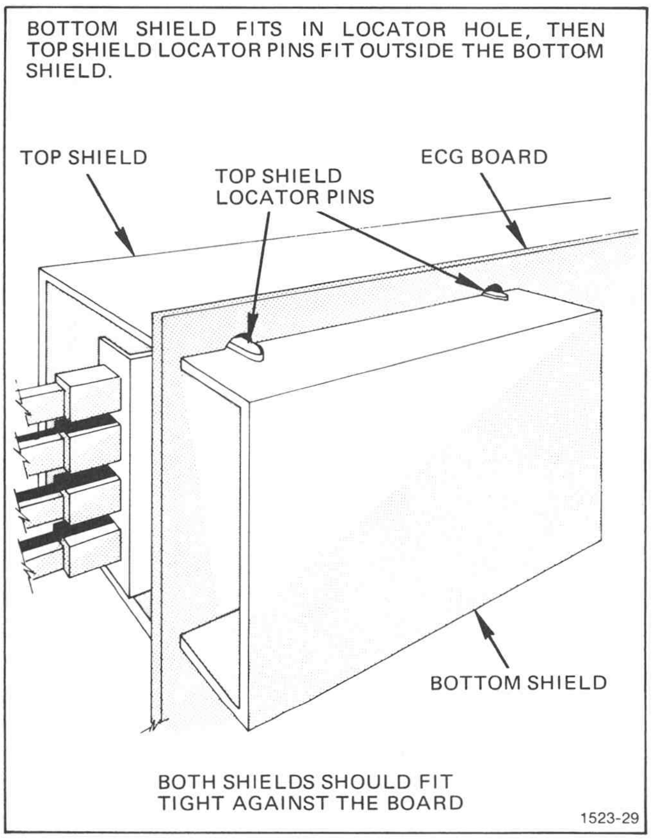


Fig. 4-10. ECG shield installation.

5. Install board retaining screws through side rail. See Figure 4-4.

6. Install push buttons on shaft extensions. Insert them through front panel and push into place. Sequence from top down: OFF, I, II, III.

7. Dress all cables away from circuit board shield, ECG INPUT connector shield, and switch shafts.

8. Install board retainer clip. See Figure 4-6.

9. Check adjustment of ECG channel and check ECG patient-circuit leakage. Refer to Adjustments section.

READOUT CONDITIONER BOARD. To remove board:

Unplug all but lower cable plugs from board. Pull board straight up to unplug. Unplug remaining cable plugs from board.

To install board: (See Cable Interconnections pull-out page in Diagrams section)

Connect the lower cable plugs to the board. Plug the board into the interface receptacles on the Main Board.

Connect remaining cables. Check temperature and rate adjustments and ECG patient-circuit leakage. See Adjustments section.

PRESSURE/PULSE BOARD. To remove board:

1. Remove PRESSURE/PULSE push buttons.

2. Unplug P2300 (10 conductor cable) from Digital Voltmeter Board.

3. Unplug three cable plugs (P401, P412, P413) from rear part of board.

4. Pull board straight up and unplug.

5. Unplug remaining cable plug (P407).

6. Remove board from monitor. Tip board as necessary to remove.

NOTE

Replacing Pressure Astable Multivibrator U476 may change the output pulse width and duty factor. The nominal pulse width is 770 µs with a nominal duty factor of 6% (measurements made at TP485). The allowable range of pulse widths is from 500 µs to 1.25 ms. The allowable duty factor range is from 5% to 20%. If the pulse is outside these ranges, change R476 and R477, as appropriate. The allowable range for R476 is from 43 kΩ to 100 kΩ(62 kΩ nominal), and the allowable range for R477 is from 750 kΩ to 1.2 MΩ(1.2 MΩ nominal).

To install board: (See Cable Interconnections pull-out page in Diagrams section)

1. Connect cable plug P407 to board.

2. Plug board into interface receptacles on Main Board. Tip board as necessary to install.

3. Connect cable plugs P413, P412, and P401 to board.

4. After installing board, check Pressure/Pulse adjustments and ECG patient circuit leakage. See Adjustments section.

DIGITAL VOLTMETER BOARD. To remove board:

Remove screw holding board to vertical support bracket.

Unplug cable plugs P2300, P2350, and P2355 from board and pull board straight up to remove.

To install board: (See Cable Interconnections pull-out page in Diagrams section)

Plug board into interface receptacles on the Main Board and connect cable plugs P2300, P2350, and P2355.

After installing board, check digital display and temperature adjustments and ECG patient-circuit leakage. See Adjustments section.

DISPLAY BOARD. To remove board:

1. Remove ECG Board and Readout Conditioner Board.

2. Unplug two interconnecting cables from Display Board.

3. Remove two mounting screws.

To remove Display Devices from Display Board:

Using a screwdriver (preferably with plastic shaft), carefully pry readout device out of its socket. Pry a little at each side until readout device is released from socket. Make sure pins are straight before attempting to install readout device.

To replace board: (See Cable Interconnections pull-out page in Diagrams section)

1. Mount Display Board in place and secure with two screws.

2. Connect two interconnecting cables.

3. Install ECG Board and Readout Conditioner Board.

4. Check ECG, temperature, and rate adjustments and check ECG patient-circuit leakage. See Adjustments section.

READOUT SELECTOR SWITCH BOARD. To remove this board, it is necessary to remove the ECG and Readout Conditioner Boards, the front panel and the two screws through the front sub panel.

After replacing the Readout Selector Switch Board, check those adjustments related to replacement of the ECG and Readout Conditioner Boards.

ALARM SWITCH BOARD. To remove board:

1. Remove front panel.

2. Remove RESET and PULSE ALARM knobs.

3. Pull HIGH RATE LIMIT control out of front subpanel. Dress cable and control clear of Alarm Switch Board.

4. Remove two screws holding board.

5. Unplug cable from board.

6. Remove board assembly (tilt back of board toward right of instrument to remove).

To install board:

Reverse the removal procedure.

Front-Panel-Mounted Components

It may not be obvious how to remove some front-panel-mounted components. Instructions for the least obvious ones are given below. For removal of the Display, Readout Switch, and Alarm Switch Boards, see Circuit Boards removal procedures given previously.

COMPLETE FRONT-PANEL ASSEMBLY. The front-panel assembly can be removed as a single unit as follows:

1. Remove ECG, Readout Conditioner, Pressure/Pulse and DVM Boards.

2. Carefully discharge anode connector to chassis.

3. Disconnect crt-anode lead. See Figure 4-11.

4. Remove four nuts, one at each inside corner of front frame casting.

5. Unplug all interconnecting cables from circuit board assemblies and remove front-panel assembly.

To install front-panel assembly:

1. Place cables into front frame casting and set front-panel assembly in place.

2. Secure assembly with four #4-40 nuts. Be careful not to pinch cable wires between front subpanel and front frame casting.

3. Connect crt-anode lead. See Figure 4-11.

4. Install circuit boards in this order: Readout Conditioner, ECG, and Pressure/Pulse. Install one board and connect cable plugs before installing the next. Attempt to keep cable wires dressed properly as you go along. See Figure 4-2.

5. After replacing front-panel assembly, check adjustment of the entire monitor. Be sure to check ECG patient-circuit leakage.

ALARM LIGHT. The ALARM light can be removed by removing the front panel. The light assembly is sandwiched between the subpanel and the front panel.

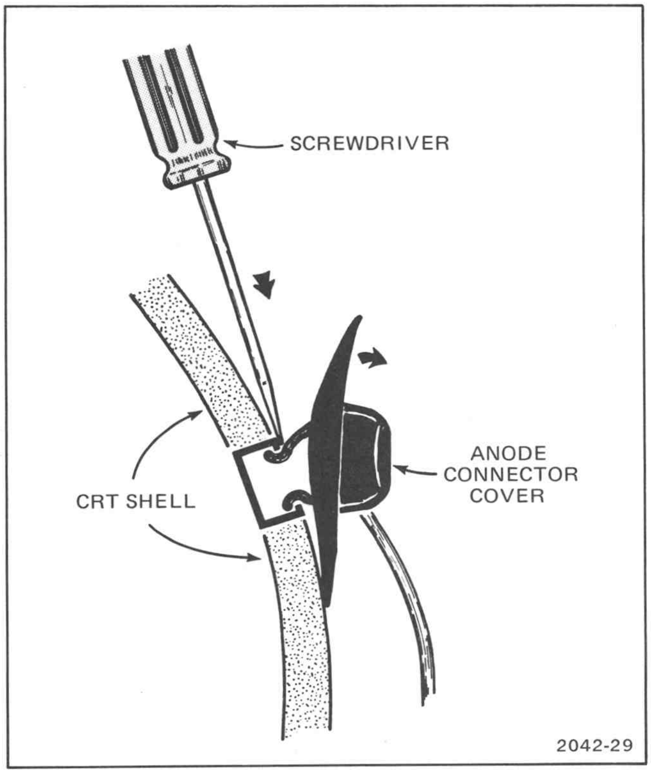


Fig. 4-11. Crt-anode connector removal and installation.

ZERO CONTROL. To replace the ZERO control, proceed as follows:

1. Remove Pressure/Pulse Board.

2. Remove four nuts at inside corners of front panel.

3. Loosen set screws holding ZERO control to front-panel mounting post. Set screw is accessible from bottom side of instrument.

4. Pull complete front-panel assembly away from front frame casting just far enough to remove ZERO control.

Install new ZERO control by transferring cable wires to new control and reversing removal procedure above. When securing front-panel assembly, be careful not to pinch cables between front subpanel and frame casting.

LEAD FAULT LED. To replace the LEAD FAULT LED (refer to Figure 4-12), proceed as follows:

1. Remove LED (light-emitting diode) holder cap by pulling it off holder.

2. Unsolder and remove LED from holder base. See caution.

CAUTION

The holder base melts easily with excessive heat. Use soldering iron of 15 watts or less.

3. Trim leads on new LED to the same length as on one removed.

4. Solder new LED to holder base, observing caution above. Note corrected orientation of cathode lead.

5. Snap holder base and LED assembly onto holder.

To remove crt:

1. Remove Digital Voltmeter Board.

2. Remove battery pack.

3. Carefully discharge anode connector to chassis.

4. Disconnect crt-anode connector as shown in Figure 4-11.

5. Unplug crt base socket and yoke plug (P841).

6. Remove loudspeaker, held with two screws through left side of instrument.

7. Remove four nuts (one at each inside corner) holding complete front-panel assembly.

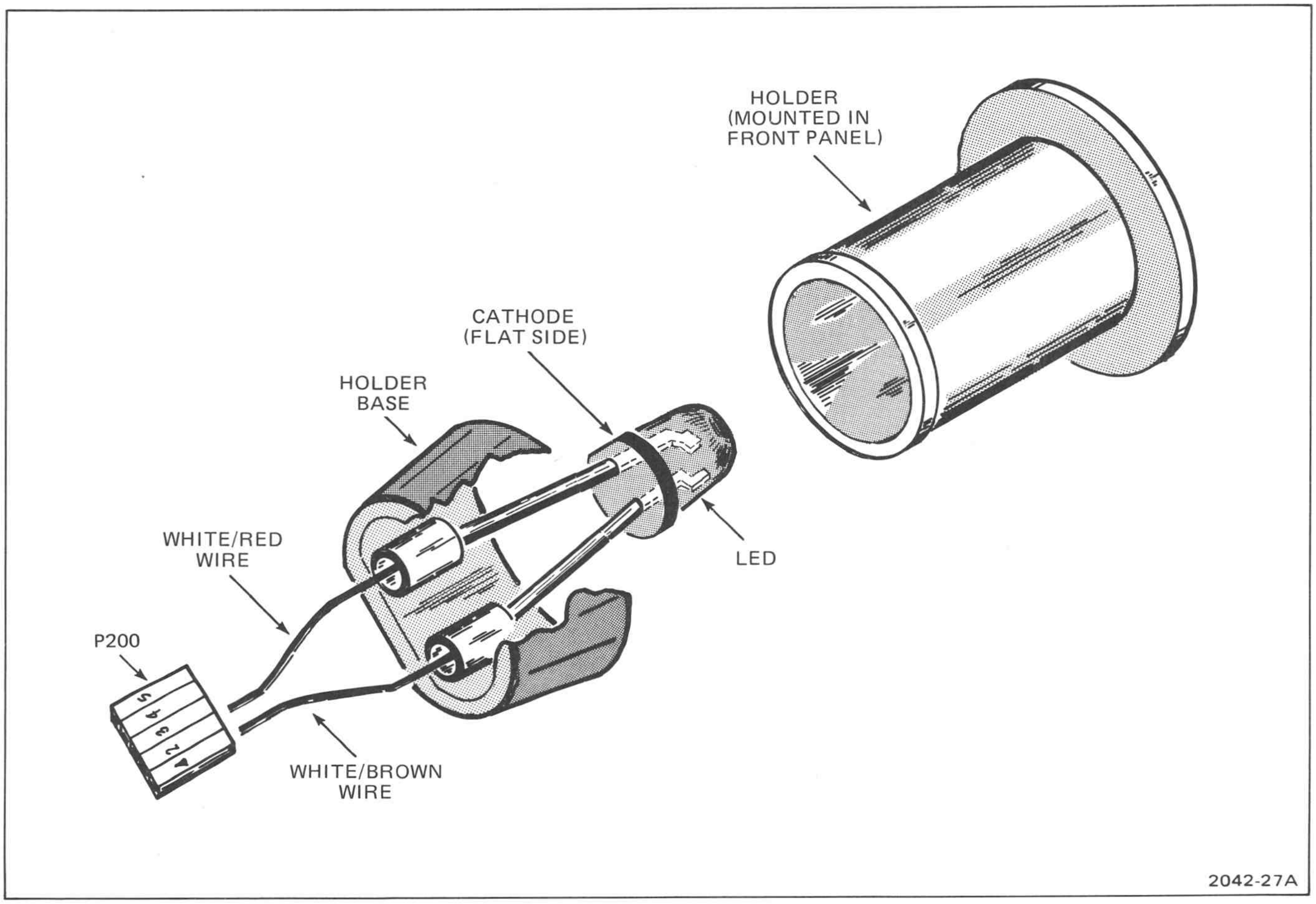


Fig. 4-12. LEAD FAULT LED replacement.

8. Pull front-panel assembly away from front frame casting just far enough to remove four long #4-40 screws holding crt retainer frame.

9. Pull crt and retainer away from front panel and remove from instrument.

To install crt:

1. Set crt and retainer frame in place against front subpanel. Make sure plastic corner pads are in place.

2. Secure crt retainer frame with four long #4-40 screws. Ears on crt retainer frame are to set into slots in front subpanel.

3. Set front-panel assembly in place and secure with four #4-40 nuts. Be careful not to pinch cable wire between front subpanel and front frame casting.

4. Replace loudspeaker.

5. Reconnect crt base socket and yoke plug (P841).

6. Reconnect crt anode connector. See Figure 4-11.

7. Replace battery pack.

8. Replace Digital Voltmeter Board.

9. After replacing crt, check following adjustments (see Adjustments section): centering rings, crt yoke, Focus (R841), Horizontal Position (R671), Horizontal Width (R667), Pressure Position (R495), and Vertical Sensitivity (R647).

ACCESSORY REPAIR

The following information should be considered when replacing or repairing accessories.

Pressure Transducers

Pressure transducers are not considered field repairable. Repair or replacement should be done by the transducer manufacturer.

All non-differential transducers have a vent tube to atmospheric pressure. In many cases, this vent tube is within the transducer cable. Do not crush or kink this cable, because doing so could close the tube and prevent calibrated operation.

Transducer cable-end connectors frequently contain selected components and are often sealed with potting compound or epoxy, so that repair is difficult or impossible. Factory replacement of connectors by the transducer manufacturer may be the only practical alternative; the original selected components may not be reusable and the factory is best equipped to reselect components.

ECG Cables

ECG cables are not considered repairable, except the tapped #4-40 connectors at the ends of the limb patient cable wires. The tapped individual electrode connectors can be repaired using a repair kit, Tektronix Part 040-0696-01.

Snap connectors should grip the electrode terminal firmly. If not, they often can be tightened by bending the contact inward gently with a scribe or small screwdriver.

ADJUSTMENTS

INTRODUCTION

IMPORTANT—PLEASE READ BEFORE USING THIS PROCEDURE

ECG LEAKAGE CHECK

ECG patient-circuit leakage must be checked following any repair or adjustment. Also, it is advisable to check leakage any time the monitor has been dropped or otherwise abused. A leakage check procedure is located at the end of the Check/Adjust Procedure and in the Maintenance section.

ADJUSTMENT INTERVAL

Monitor performance should be checked and adjustments made at least every two years. Complete performance should also be checked after any repair, if the monitor has not been readjusted within the past year. Partial or complete readjustment should be performed following specific repairs; see the Maintenance section.

PARTIAL ADJUSTMENT

Partial adjustment is often desirable after replacing components or just to touch up the adjustment of a portion of the monitor between major performance checks.

Many adjustments can be made independently without affecting the adjustment of other portions of the monitor. However, if the −12 volt adjustment is changed, it will be necessary to check the performance of the entire monitor. Refer to Table 5-1 to determine which adjustments should be made when replacing circuit board assemblies and the cathode-ray tube (crt).

TABLE 5-1
Adjustments Needed After Assembly Replacement

(1) If These Assemblies Are Replaced ↓ / (2) These Adjustments Must Be Checked or Adjusted →	A. POWER SUPPLY AND DISPLAY	−12 Volts—R737	Focus—R841	Horiz Position—R671	Horiz Width—R667	Crt Centering Rings	Trace Alignment—Yoke	B. ECG	Input Offset Null—R170	Dc Level—R185	Gain—R184	C. DIGITAL DISPLAY	DVM Zero—R2334	DVM Cal—R2332	D. TEMPERATURE	Temp Span—R1410	°F Cal—R1424	°C Cal—R1420	E. PRESSURE/PULSE	Gauge Factor—R456	Pres Pos—R495	Vert Sens—R647	F. RATE	Rate Cal—R1215
MAIN BOARD		X	X	X	X				X	X	X	X	X	X		X	X	X		X	X	X		X
ECG BOARD									X	X	X													
PRESSURE/PULSE BOARD																				X	X	X		
READOUT CONDITIONER BOARD																X	X	X						X
DIGITAL VOLTMETER BOARD													X	X		X	X	X						
DISPLAY BOARD	FUNCTIONAL CHECK ONLY																							
CATHODE-RAY TUBE (CRT)			X	X	X	X	X														X	X		

ADJUSTMENT PROCEDURES

There are two procedures in this section; a Check/Adjust procedure and an Abridged Adjustment procedure. The Check/Adjust Procedure is intended for complete monitor calibration. The Abridged Adjustment Procedure is intended to permit rapid touch-up of all internal controls.

TEST EQUIPMENT REQUIRED

The test equipment and accessories listed in Table 5-2 are required for complete adjustment of the 414 Monitor. The specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment should be correctly calibrated and operating within the manufacturers specifications.

Special Test Accessories

The special test accessories required for adjustment can be readily constructed using common electronic components. Be sure to use components with at least the accuracy specified.

TABLE 5-2
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Function generator	Output Amplitude, 1 V square wave; Risetime, 10 μs or faster; Frequency Range, 0.5 Hz to 10 Hz; Frequency Accuracy.[1]	Horiz Width, ECG Gain and Rate Cal adjustments. Pacer Signal Rejection and ECG output checks.	Tektronix FG 501 Function Generator.[2]
2. Test oscilloscope	Bandwidth, dc to at least 500 kHz; Minimum Vertical Deflection Factor, 1 mV/div; Sweep Rates, 10 μs/div to 200 ms/division.	ECG Gain and Input Offset Null adjustments, QRS Timing, QRS Width, Rate Alarms, and Isolation checks. Function generator frequency verification.	Tektronix 212 Oscilloscope.
3. Time-mark generator	Marker Outputs, 1 second; Marker Accuracy, within 0.1%.	Function generator frequency verification.	Tektronix TG 501 Time-Mark Generator.[2]
4. Digital voltmeter (test DVM)	Range, −12 to +2.5 V dc; Accuracy, within 0.1%.	−12 volt, DVM Zero, DVM Cal, and Temp Span adjustments Pressure/Pulse output checks.	Tektronix DM 501 Digital Multi-meter.[2]
5. Manometer	Range, 0 to 250 mmHg; Accuracy, within 1%.	Pressure checks and adjustments.	
6. Pressure transducer	Standardized to 50 μV/V/cmHg.	Pressure checks and adjustments.	

[1] The frequency accuracy of the function generator used for the Rate Cal adjustment should be within 1% or better. If a function generator is not available with this accuracy, use a time-mark generator timing standard and a test oscilloscope, as follows, to set the 1 Hz, 2 Hz, 3 and 4 Hz frequencies needed.

a. Connect function generator output to test oscilloscope vertical input.
b. Set desired frequency on function generator frequency dial.
c. Externally trigger test oscilloscope sweep (in NORMAL trigger mode, not automatic) using 1 second time mark from time-mark generator.
d. Readjust function generator frequency dial slightly on either side of the 1, 2, 3, or 4 Hz dial setting until rising or falling edge of square wave appears at same point with each succeeding sweep.

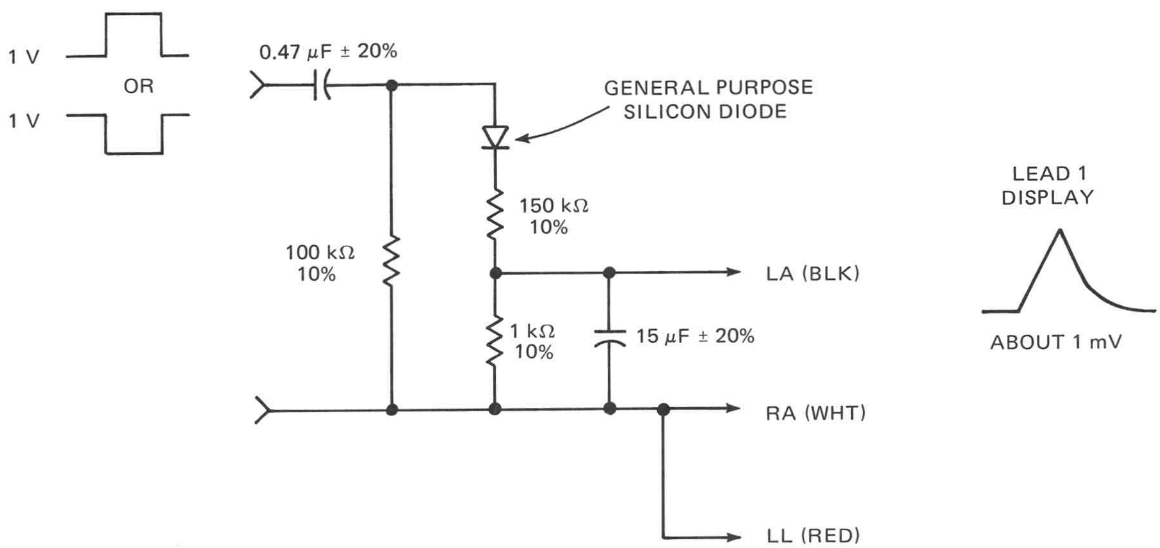
[2] Requires TM500 Power Module.

TABLE 5-2 (CONT.)
Test Equipment

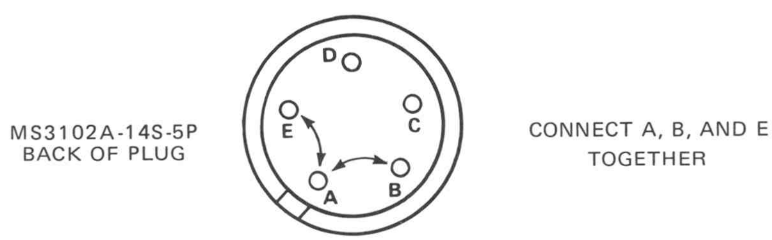
Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
7. Pulse sensor		Pulse checks.	Tektronix Pulse Sensors: 015-0236-01 (finger) 015-0237-01 (radial).
8. Low-pass filter and attenuator	Fig. 5-1A.	Horiz Width, ECG Gain, and Rate Cal adjustments. ECG output checks.	
9. ECG shorting connector	Fig. 5-1B.	Input Offset Null and DC Level adjustments.	
10. Stereo phone plug	Fig. 5-1C.	DC Level and ECG Gain adjustments. Pressure/Pulse output checks.	
11. Precision attenuator	Fig. 5-2A.	ECG Gain check.	
12. CMRR-leakage test fixture	Fig. 5-2B.	CMRR and Leakage checks.	
13. Pacer input circuit adapter	Fig. 5-2C.	Pacer Signal Rejection checks.	
14. Temperature sensor substitution plugs	Fig. 5-3.	DVM Cal and °F/°C Cal adjustments.	
15. Safety Analyzer			Neutrodyne-Dempser Model 431 or equivalent.

A. LOW-PASS FILTER AND ATTENUATOR

THE VALUES WERE SELECTED TO DETERIORATE PULSE RISETIME, PERMITTING THE QRS DETECTOR AND TRIGGER TO FUNCTION AND TO PROVIDE A SINGLE POSITIVE PULSE DISPLAY FOR EACH SQUARE WAVE.

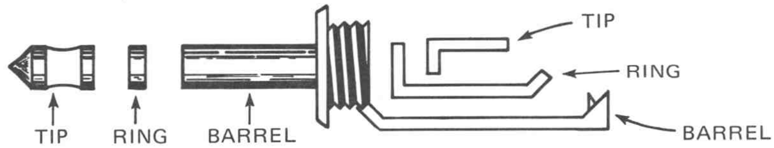


B. ECG SHORTING CONNECTOR



C. STEREO PHONE PLUG

A STEREO PHONE PLUG WITH ITS COVER REMOVED MAKES A CONVENIENT TEST POINT FOR OBTAINING OUTPUT SIGNAL.



2042-1

Fig. 5-1. Wiring details for the low-pass filter and attenuator, ECG shorting connector, and stereo phone plug test fixtures.

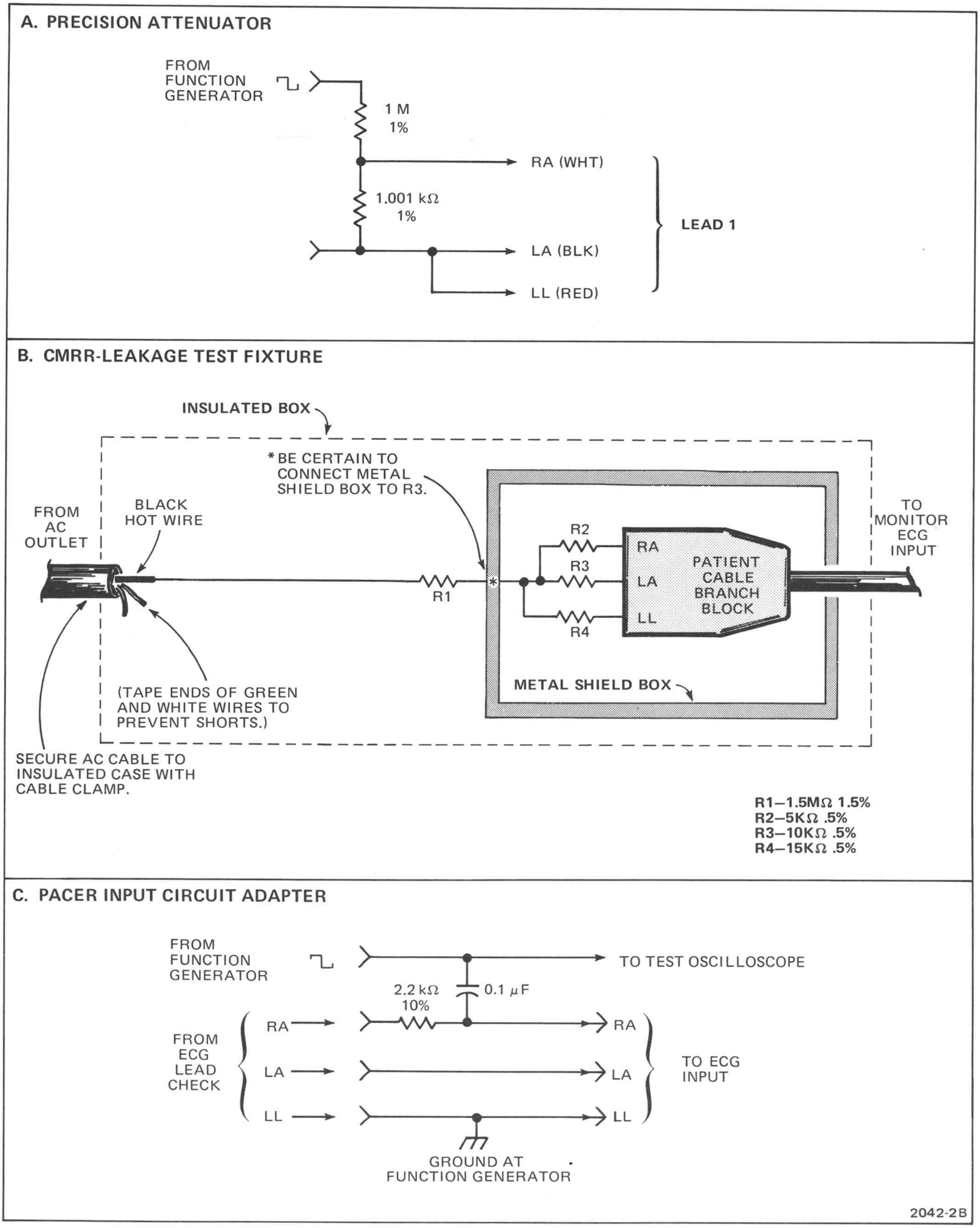
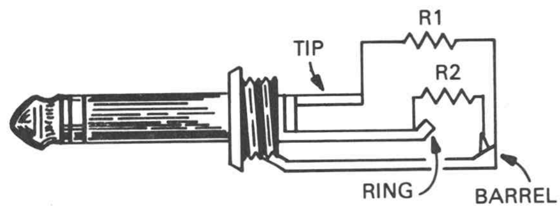


Fig. 5-2. Wiring details for the precision attenuator, pacer input circuit adapter, and CMRR-leakage test fixtures.



°F	°C	R1(Ω)	TEKTRONIX Part Number	R2(Ω)	TEKTRONIX Part Number
23	−5	25.40 K	321-1690-07	122.1 K	321-1692-07
41	5	15.24 K	321-1688-07	74.44 K	321-1691-07
77	25	6000	321-1696-07	30.00 K	321-0685-07
113	45	2620	321-1694-07	13.28 K	321-1687-07
98.6	37	3610	NONE	18.21 K	NONE

NOTES:

1. RESISTORS USED FOR THESE PLUGS SHOULD HAVE VALUES WITHIN 0.1% AND HAVE LOW TEMPERATURE COEFFICIENTS.
2. ANY SERIES OR PARALLEL COMBINATION OF QUALITY RESISTORS CAN BE USED TO PRODUCE VALUES OF R1 AND R2.
3. 98.6°F/37°C IS NOT NEEDED FOR ADJUSTMENT PROCEDURE; IT IS GIVEN FOR REFERENCE ONLY.
4. 23°F/−5°C RANGE CHECKED IN 400 RECORDER ONLY.

2042-101

Fig. 5-3. Temperature sensor substitution plugs.

PRELIMINARY CONSIDERATIONS

Earth's Magnetic Field

Vertical and horizontal trace positioning can be affected slightly be the position of the monitor in relation to the earth's magnetic field. Unless the monitor is kept upright when adjusting the spot centering and horizontal positioning, it may not be possible to match the user's display precisely.

Reference Letters and Test Points

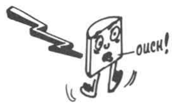
TP—12 V, TP1585, etc, and references to letters surrounded by hexagons, refer to points indicated on the schematics and Adjustment Locations pullout pages.

WARNING

High voltage and high battery current capabilities exist inside the monitor. Voltages of over 15 volts are low-current sources and are not considered dangerous, but could produce an electrical shock. All ac line-voltage connections are covered and located on the rear panel.

Disassembly for Adjustment

Remove the four screws from each side. Pull the bottom cover straight away from the monitor. Lift the left side of top cover to permit the right side to clear the ECG LEAD CHECK terminals. If further disassembly is needed for repair or replacement of components, refer to the Maintenance section and the mechanical drawing pullout pages.



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Storing and Transporting

Don't *remove semiconductors or boards containing semiconductors from original antistatic container until needed.*

Don't *store or transport semiconductors or boards containing semiconductors in plastic containers, styrofoam or other nonconductive material, unless specifically treated for antistatic qualities.*

Installing

Do *discharge any static charge you may have accumulated before handling semiconductors or boards containing semiconductors.*

Do *use grounded soldering iron and test equipment.*

Do *turn the instrument power off before removing or inserting semiconductors.*

Do *use a static free surface when working on boards or instruments containing semiconductors. (A sheet of card board should be placed over non-antistatic treated plastic work surfaces.)*

Don't *slide semiconductors or boards containing semiconductors across any surface.*

Don't *touch semiconductor leads unless necessary.*

2042-100

CHECK/ADJUST PROCEDURE

For adjustments and test points, see ADJUSTMENT AND TEST POINT LOCATIONS pullout pages.

PURPOSE

The purpose of this procedure is to permit the complete adjustment of an operating monitor; it is not intended as a trouble-shooting guide. The procedure is divided by major functions to make it easier to adjust individual portions of the monitor.

Some monitor specifications are not verified by this procedure. Additional information can be found in the Specification section on the schematics.

OPERATING TEMPERATURE

The monitor should be adjusted at an ambient temperature of +20° to +30° C for best overall accuracy.

PRELIMINARY CHECK

Operation of all modes should be checked and any defects corrected before attempting to adjust the monitor.

PRELIMINARY SETUP

POWER	in (on)
DISPLAY OFF	in (off)
OFF (ECG)	in (off)
ALARM LOW RATE LIMIT	RATE ALARM OFF (ccw)
SWEEP SPEED mm/SEC 100	in

Set the remaining controls as desired. Connect the monitor to the correct ac line source.

DO NOT PRESET INTERNAL CONTROLS

A. POWER SUPPLY AND DISPLAY

Equipment Required

1. Digital voltmeter (test DVM)
2. Function generator
3. Low-pass filter (Fig. 5-1A)

A1. −12 VOLTS

a. Connect test DVM leads between the ground labeled point A and TP−12 V. (See Adjustment Locations pull-out page.)

b. CHECK—Supply voltage should be −12.0 V, within 25 mV.

NOTE

Do not readjust −12 V supply if it is within 25 mV unless a complete recalibration is intended.

c. ADJUST— −12 volts (R737) for −12.0 V.

d. Remove DVM leads.

A2. TRACE ROTATION

a. CHECK—Trace should be parallel with graticule lines.

WARNING

Be careful when making yoke adjustments; there is + and −35 V at the yoke, +175 V in the crt socket and +3400 V on the crt anode.

b. Loosen yoke clamp (Fig. 5-4).

c. ROTATE—Yoke for non-tilted trace (Fig. 5-4). Keep yoke forward as far as possible.

d. Tighten yoke clamp.

NOTE

Due to effects of earth's magnetic field, monitor should be positioned upright when performing steps A3, A4, and A5. Monitor will have to be supported above bench to make adjustments.

A3. SPOT CENTERING AND FOCUS

a. Set POWER button out (off) and disconnect yoke plug, P641. Set POWER button in (on).

b. CHECK—Spot should be centered on graticule, within 2 mm.

c. ADJUST—Centering Rings for centered spot. Refer to Fig. 5-5.

d. CHECK—Spot should be finely focused.

e. ADJUST—Focus (R841) for smallest possible round spot.

f. Set POWER button out (off) and reconnect yoke plug. Be sure to match arrow on plug with arrow on main board. Set POWER button in (on).

A4. HORIZONTAL POSITION

a. CHECK—Trace should start at left end of graticule lines, within 2 mm.

b. ADJUST—Horiz Position (R671) so that trace starts at left end of graticule lines.

A5. HORIZONTAL WIDTH

a. Set: ECG I — in

SWEEP SPEED mm/SEC 50 — in

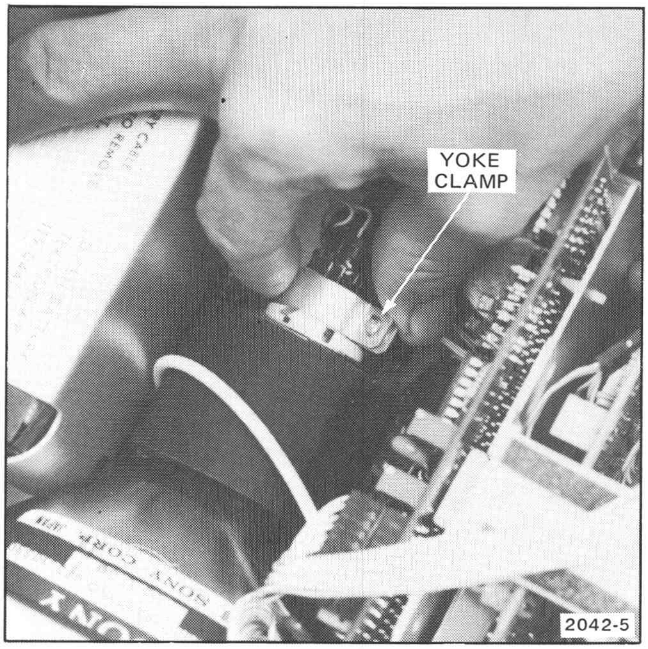


Fig. 5-4. Deflection yoke adjustment.

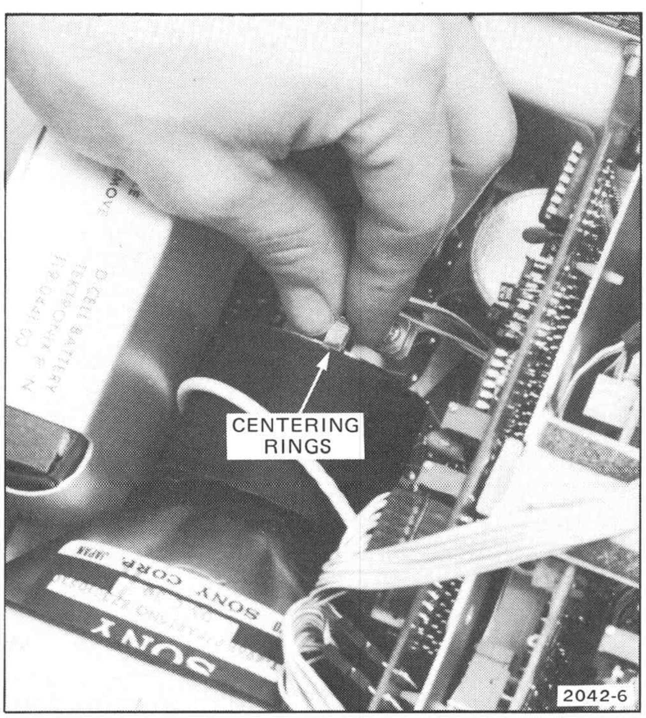


Fig. 5-5. Yoke connector, P641, and spot centering rings.

b. Connect function generator square wave through Low-Pass Filter (Fig. 5-1A) to ECG INPUT connector and display approximately 4 cm at 3 Hz, within 2%. Monitor should produce beat tone and triggered display.

c. CHECK—Fourth pulse leading edge should coincide with 60 BEATS/MIN mark within 2 mm (Fig. 5-6A).

d. ADJUST—Horiz Width (R667) to make fourth pulse leading edge coincide with 60 BEATS/MIN mark.

e. CHECK—100 mm/SEC sweep speed (see Fig. 5-6B).

f. CHECK—25 mm/SEC sweep speed (see Fig. 5-6C).

The 25 mm/SEC sweep speed is not triggered. Therefore, it will be necessary to measure the distance between pulses using a centimeter rule.

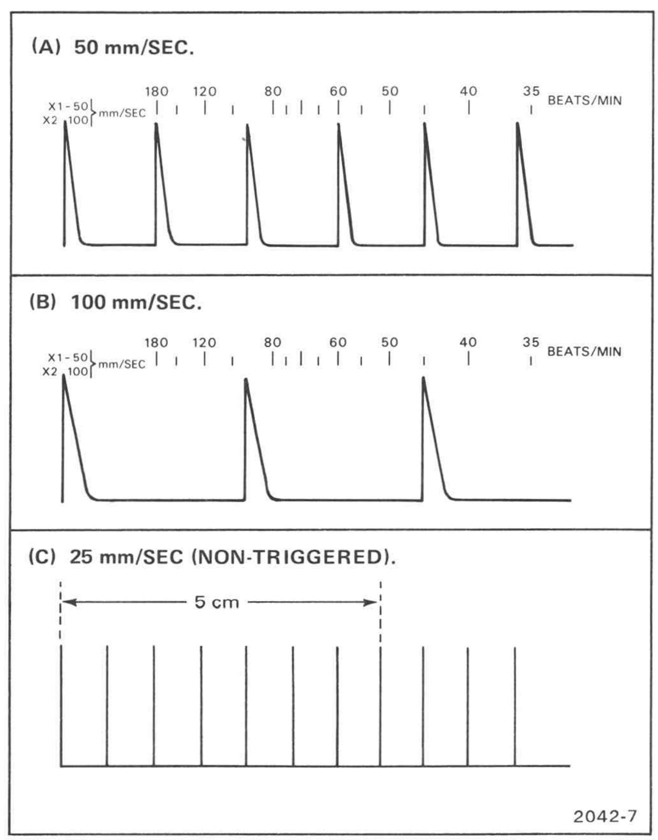


Fig. 5-6. Horizontal width adjustment.

B. ECG

Equipment Required

1. ECG shorting connector (Fig. 5-1B)
2. Test oscilloscope
3. Stereo phone plug (Fig. 5-1C)
4. Function generator
5. CMRR/leakage test fixture (Fig. 5-2B)
6. Precision attenuator (Fig. 5-2A)

B1. INPUT OFFSET NULL

a. Set: DISPLAY OFF in (off)
ECG I in (on)

b. Connect ECG shorting connector (Fig. 5-1B) to ECG INPUT connector.

c. CHECK—Voltage at TP178 should be 0.0 V, within 200 mV. Use test oscilloscope.

d. ADJUST—Input Offset Null (R170) for 0.0 V.

B2. DC LEVEL

a. Insert stereo phone plug (Fig. 5-1C) into ECG OUTPUT connector.

b. CHECK—ECG OUTPUT (TIP X1000) should be 0.0 V, within 25 mV. Use test oscilloscope.

c. ADJUST—DC Level (R185) for 0.0 V.

d. CHECK—Trace is vertically centered at 150 mmHg line, within 3 mm.

e. Remove ECG shorting plug.

B3. ECG OUTPUT GAIN

a. Connect function generator to test oscilloscope and through precision attenuator (Fig. 5-2A) to ECG INPUT connector. Apply 1.0 V, 10 Hz sine wave. Note reference amplitude on test oscilloscope. Then connect test oscilloscope to ECG OUTPUT (TIP X1000).

b. CHECK—ECG OUTPUT (TIP X1000) should be equal to reference amplitude (÷1000 attenuator and X1000 monitor gain = 1).

c. ADJUST—Gain (R184) for output equal to reference amplitude.

d. Move test oscilloscope to ECG OUTPUT (RING X1).

e. CHECK—ECG OUTPUT (RING X1) for approximately 1.0 mV p-p.

f. Disconnect test oscilloscope, function generator, stereo phone plug and precision attenuator.

B4. ECG LEAD CHECK SIGNAL

a. Connect ECG LEAD CHECK signal to ECG INPUT connector through patient cable. Leads connect front to back as follows: LL (red), LA (black), RA (white).

b. CHECK—Positive-going pulses should be approximately 100 bpm (not critical). Rise and fall times are slow to activate QRS detector.

c. Set ECG SIZE to 20 mm/mV.

d. CHECK—Approximate pulse amplitude for each of the three ECG lead configurations is as follows: I, 2 cm; II, 3 cm; III, 1 cm.

B5. LEAD FAULT OPERATION

a. CHECK—LEAD FAULT lamp lights when any ECG lead is removed from an ECG LEAD CHECK terminal.

b. Reconnect lead to ECG LEAD CHECK terminal.

B6. QRS TIMING

a. Connect test oscilloscope to TP382 (CH 1) and to TP388 (CH 2). Trigger oscilloscope on CH 1 (+SLOPE).

b. CHECK—Interval between first positive-going edge at TP is 6 ms, within 1 ms (see Fig. 5-7).

B7. QRS WIDTH

a. Set test oscilloscope to CH 1. Trigger oscilloscope on composite or normal, +SLOPE.

b. CHECK—Pulse duration at TP388 is 150 ms, within 25 ms (see Fig. 5-8).

c. Disconnect test oscilloscope.

B8. PACER SIGNAL REJECTION

a. Connect pacer input circuit adapter and function generator as shown in Fig. 5-2C.

b. Set function generator output for approximately 500 mV, 1 Hz square wave.

c. Set monitor ECG I button in.

d. CHECK—QRS detector should respond only to ECG LEAD CHECK signal and not to simulated pacer signal. When pacer signal coincides with leading edge of ECG LEAD CHECK signal, QRS selection should occur at trailing edge.

e. Disconnect function generator and pacer input circuit adapter.

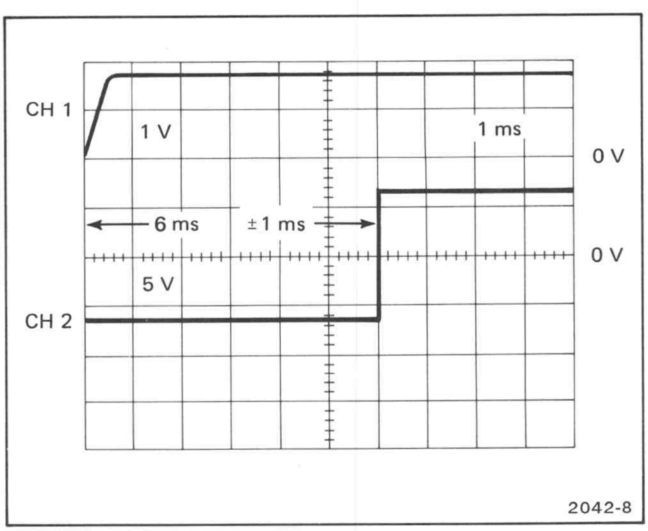


Fig. 5-7. QRS timing.

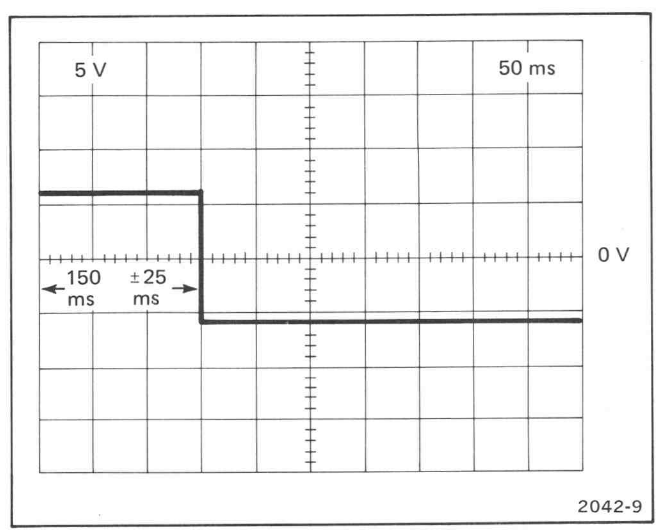


Fig. 5-8. QRS width.

C. DIGITAL DISPLAY

Equipment Required

1. Digital voltmeter (test DVM)
2. Temperature sensor substitution plug (113°F/45°C) (Fig. 5-3)

C1. DVM ZERO AND DVM CAL

a. Set:

ECG OFF	in (off)
PRESSURE 150	in
DISPLAY OFF	in (off)
MEAN	in
°C/°F	°F
POWER	out (off)

b. Connect pressure transducer to PRESSURE TRANSDUCER INPUT connector on rear panel.

c. Connect LO (—) input of test digital voltmeter (DVM) to TP GND 1 and HI (+) input to TP1012.

d. Set POWER button in (on).

e. Press in pressure ZERO control and adjust to read between .0020 and .0100 V on test DVM. Do not attempt to set for .0000 V.

f. Release ZERO control and wait for test DVM reading to stabilize.

g. CHECK—414 digital display reads one number less than test DVM (rounded off to nearest count). For example, if test DVM reads .0023, the 414 digital display should read 1 or if test DVM reads .0026, the 414 digital display should read 2.

h. ADJUST—DVM Zero (R2334) so that digital display reads one number less than test DVM (rounded off).

i. Set TEMP button in. Display should blank.

j. Insert a 113°F temperature sensor substitution plug[1] (Fig. 5-3) into TEMPERATURE SENSOR INPUT jack on rear panel.

k. CHECK—414 digital display reads same number (rounded off) as test DVM.

l. ADJUST—DVM Cal (R2332) so that 414 digital display reads same number as test DVM.

NOTE

If DVM Cal setting was ***not*** *changed, omit steps m and n.*

m. Set MEAN button in.

n. INTERACTION—Occurs between DVM Zero and DVM Cal adjustments. Repeat steps g through l as necessary.

o. Remove temperature sensor substitution plug and test DVM.

---

[1] **The 113°F temperature sensor substitution plug is used to produce an arbitrary high number on the digital display, which is just below the over-range point, for use in setting the DVM Cal adjustment. If 0.1% resistors are not available to make the 113°F substitution plug, use the closest 1% values (e.g., 2.61 K for R1 and 13.3 K for R2). Other value combinations can also be used. The important consideration is to produce a reading on the test DVM between 1.00 V and 1.20 V.**

D. TEMPERATURE

Equipment Required

1. Digital voltmeter (test DVM)
2. Temperature sensor substitution plugs (Fig. 5-3)

NOTE

To ensure specified temperature readout accuracy, the temperature readout adjustments should be set at a Tektronix Medical Products Service Center. If this is not feasible, use the following method to make these adjustments. The accuracy of these adjustments depends directly on the quality and accuracy of the resistors used in the temperature sensor substitution plugs.

D1. TEMP SPAN

a. Set:

TEMP	in
°C/°F	°F
POWER	out (off)

b. Connect LO (—) input of test DVM to TP GND 1, and HI (+) input to TP+1.76 V.

c. Set POWER button in (on).

d. CHECK—Test DVM reads 1.759 within 1 V.

e. ADJUST—Temp Span (R1410) so that test DVM reads 1.759 V.

D2. °F CAL AND °C CAL

a. Insert 77°F temperature sensor substitution plug (Fig. 5-3) into TEMPERATURE SENSOR INPUT jack on rear panel.

b. Using Table 5-3, check or adjust digital display of simulated temperature values.

c. Remove test DVM and temperature sensor substitution plug.

TABLE 5-3
°F and °C Readout Checks and Adjustments

°F/°C Switch	Temperature Sensor Substitution Plug (Fig. 5-1D)	414 Digital Display Reading[1]	Check/Adjust
°F	77°F/25°C	77.0 ± 0	CHECK
°F	77°F/25°C	77.0 ± 0	ADJUST °F Cal (R1424)
°C	77°F/25°C	25.0 ± 0	CHECK
°C	77°F/25°C	25.0 ± 0	ADJUST °C Cal (R1420)
°C	41°F/5°C	5.0 ± 0.1	CHECK
°F	41°F/5°C	41.0 ± 0.2	CHECK
°F	113°F/45°C	113.0 ± 0.2	CHECK
°C	113°F/45°C	45.0 ± 0.1	CHECK

[1] If you can not obtain accuracy indicated, it will be necessary to repeat the Temp Span, °F Cal and °C Cal adjustments and slightly compromise the settings.

E. PRESSURE/PULSE

Equipment Required	
1. Manometer	4. Stereo phone plug (Fig. 5-1A)
2. Pressure transducer	5. Pulse sensor
3. Digital voltmeter	

E1. GAUGE FACTOR

a. Set:

PRESSURE 250	in
DISPLAY OFF	in (off)
PULSE ALARM	out (off)
MEAN	in

b. Connect manometer to pressure transducer and pressure transducer to PRESSURE TRANSDUCER INPUT connector on rear panel.

c. Press in Pressure ZERO control and adjust for digital display reading of +0.

d. Apply 250 mmHg pressure as indicated by manometer. Make sure pressure remains at 250 mmHg and is not diminishing slowly.

e. CHECK—Digital display reads 250, within 1 mmHg.

f. ADJUST—Gauge Factor (R456) for digital display reading of 250.

g. Release manometer pressure.

h. CHECK—Digital display reads 0, within 1 mmHg.

i. INTERACTION—Can occur between Pressure ZERO and Gauge Factor adjustments. Repeat steps c through g as necessary to make difference between ZERO and 250 mmHg digital display readings, 250, within 1 mmHg.

j. Press in Pressure ZERO control and adjust for digital display reading of ± 0.

k. Apply 150 mmHg pressure as indicated by manometer.

l. CHECK—Digital display reads 150, within 1 mmHg.

m. Apply 25 mmHg (50 in Option 21 instruments, see Option Section) pressure as indicated by manometer.

n. CHECK—Digital display reads 25, within 1 mmHg.

o. Set:

SYST/DIAST	in
PRESSURE 250	in

p. Apply 250 mmHg pressure as indicated by manometer.

q. CHECK—Digital display reads 250, within 3 mmHg.

r. Release manometer pressure.

E2. PRESSURE POSITION AND VERTICAL SENSITIVITY

a. Set:

PRESSURE 250	in
DISPLAY OFF	out (on)

b. Press in Pressure ZERO control and adjust for digital display reading of ± 0. Release ZERO control.

c. CHECK—Trace should coincide with ZERO graticule line within 1 mm.

d. ADJUST—Pressure Position (R495) to make trace coincide with ZERO graticule line.

e. Apply 250 mmHg pressure as indicated by digital display.

f. CHECK—Trace should coincide with 250 mmHg graticule line within 1 mm.

g. ADJUST—Vertical Sensitivity (R647, main board) to correct one half of error.

h. INTERACTION—Occurs when adjusting Vertical Sensitivity. Repeat the Pressure Position and Vertical Sensitivity adjustments as necessary.

E3. PRESSURE/PULSE OUTPUT

a. Release manometer pressure.

b. Insert stereo phone plug (Fig. 5-1C) into PRESSURE/PULSE OUTPUT jack and connect test DVM between tip and barrel (chassis ground).

c. Press in Pressure ZERO control and adjust for digital display reading of ± 0. Release ZERO control.

d. CHECK—Test DVM reads 0 within 50 mV.

e. Apply 250 mmHg pressure as indicated by 414 digital display.

f. CHECK—Test DVM reads 2.5 V within 50 mV.

g. Remove DVM and stereo phone plug.

E4. PRESSURE ALARM

a. Set ALARM LOUDNESS (rear panel) to midrange.

b. Simulate a pulsatile pressure display by pressing and releasing the 100 mm CHECK button approximately once every second. Set PULSE ALARM in (on). Continue to press and release 100 mm CHECK button for more than 30 seconds and check that alarm is not triggered.

c. Stop pressing 100 mm CHECK button.

d. CHECK—Alarm is triggered within about 30 seconds.

e. Set PULSE ALARM button out (off).

f. Disconnect manometer and pressure transducer.

E5. PULSE DISPLAY

a. Set PULSE button in.

b. Connect pulse sensor to PULSE SENSOR INPUT on rear panel and monitor your pulse.

c. CHECK—Monitor displays pulse. Digital display is blanked.

E6. PULSE ALARM

a. Set PULSE ALARM button in (on).

b. CHECK—Alarm is not triggered after waiting more than 30 seconds.

c. Disconnect pulse sensor.

d. CHECK—Alarm is triggered within 3-15 seconds.

e. Push ALARM RESET.

f. CHECK—Alarm ends and then is triggered again within 3-15 seconds.

g. Set PULSE ALARM button out (off).

F. RATE

Equipment Required

1. Function generator
2. Low-pass filter (Fig. 5-1A)
3. Time-mark generator
4. Test oscilloscope

F1. RATE CAL

a. Set:

ECG I	in
LOW RATE LIMIT	RATE ALARM OFF
RATE	in
DISPLAY OFF	in (off)

b. Connect function generator square wave through low-pass filter (Fig. 5-1A) to ECG INPUT connector and display about 4 cm at 3 Hz, within 2% (or 180 bpm). See footnote 1 under Test Equipment Required.

c. CHECK—Digital display reads 180 within 3 bpm after 15 seconds.

d. ADJUST—Rate Cal (R1215) so that digital display reads 180.

e. Set function generator to 1 Hz.

f. CHECK—Digital display reads 60, within 2 bpm after 15 seconds.

g. Set function generator to 4 Hz.

h. CHECK—Digital display reads 240 within 4 bpm after 15 seconds.

i. Turn off function generator.

j. CHECK—Digital display reads 0 bpm to 2 bpm after 15 seconds.

k. Turn on function generator.

F2. RATE ALARM LIMITS

a. Set function generator frequency to read 120 within 1 bpm (2 Hz) on digital display.

b. Set:

ALARM LOUDNESS (rear panel)	Midrange
LOW RATE LIMIT (press in for digital display)	116
HIGH RATE LIMIT (press in for digital display)	124

c. Press LOW RATE LIMIT control in and set to read 124 on digital display.

d. CHECK—Alarm tone sounds and alarm light turns on within 30 seconds.

e. Set LOW RATE LIMIT to read 116 on digital display.

f. Press RESET button to reset the alarm.

g. Press HIGH RATE LIMIT control in and set to read 116 on digital display.

h. CHECK—Alarm tone sounds and alarm light turns on within 30 seconds.

i. Set LOW RATE LIMIT control to RATE ALARM OFF.

j. Set HIGH RATE LIMIT control to 90 (printed on front panel). Press control in and check that digital

display reads 90 within 15 bpm. Repeat at 120, 150, 180, 210, and 240. Check that front panel settings and digital display are within 15 bpm. Loosen set screw and readjust knob on shaft to make front panel settings and digital display within 15 bpm.

k. Set HIGH RATE LIMIT fully clockwise and reset alarm if necessary.

l. Set LOW RATE LIMIT control to 30 (printed on front panel). Press control in and check that digital display reads 30 within 15 bpm. Repeat at 60, 90, 120, and 150. Check that front panel settings and digital display are within 15 bpm.

m. Disconnect function generator and low-pass filter.

G. ECG LEAKAGE AND COMMON MODE REJECTION RATIO (CMRR)

G1. ECG LEAKAGE CHECK

This check determines the amount of leakage current that could be present between the patient and the ECG circuit of the monitor under either of the following abnormal conditions: (1) monitor is properly grounded and patient is at 120 V ac, 60 Hz, or (2) monitor is not grounded, case is connected to 120 V ac, 60 Hz, and patient is grounded.

Test Equipment Required

Use an instrument such as the Model 431 Safety Analyzer, manufactured by Neutrodyne-Dempsey Inc., P.O. Box 1925, Carson City, Nevada.

Leakage Check Procedure

a. Disconnect monitor from ac power source.

b. Remove top and bottom covers.

c. CHECK—All plug-in circuit boards are pushed firmly into their mating receptacles.

d. CHECK—All cables are plugged firmly into their mating pins and that they are dressed away from ECG shield, input connector shield, and pushbutton switch shafts.

e. CHECK—Screw and spacer securing ECG circuit board are tight (see Fig. 5-9).

f. CHECK—Plastic board retainer is installed and properly seated at top of circuit boards (see Fig. 4-6).

g. Replace top and bottom covers. Leakage check is valid only with covers installed.

h. Check ECG-leakage current using procedure supplied by the Safety Analyzer manufacturer.

G2. ECG CMRR CHECK

a. Connect CMRR test fixture (Fig. 5-2B) to ECG INPUT connector. Then connect test circuit to ac-power line.

b. Set ECG SIZE control to midrange mark (20 mm/mV).

c. Set ECG I button in.

d. CHECK—Monitor display amplitude should be less than 1.3 cm p-p for nominal 115 V lines (or less than 2.6 cm p-p, for nominal 230 V lines, if the lines are unbalanced).

e. Set ECG III in.

f. Repeat part d.

g. Set ECG II in.

h. CHECK—Monitor display amplitude should be less than 1.9 cm p-p for nominal 115 V lines (or less than 3.8 cm p-p, nominal 230 V lines, if the lines are unbalanced).

i. Disconnect CMRR test fixture.

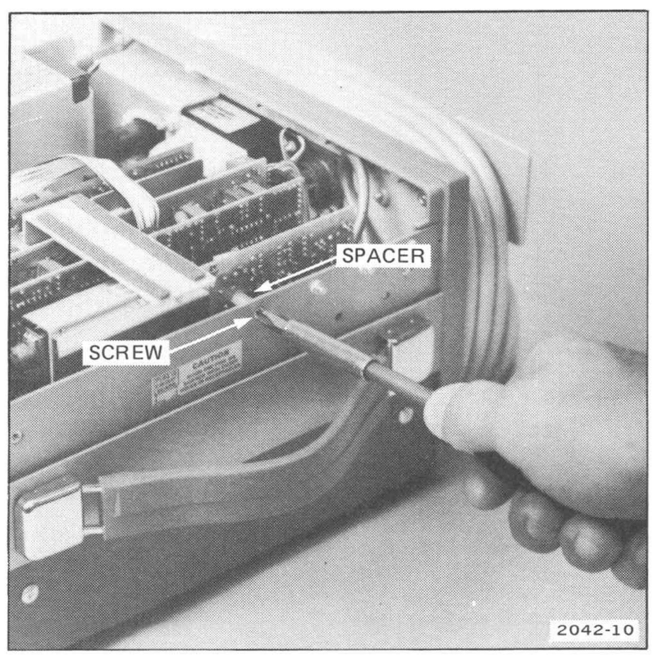


Fig. 5-9. ECG board securing.

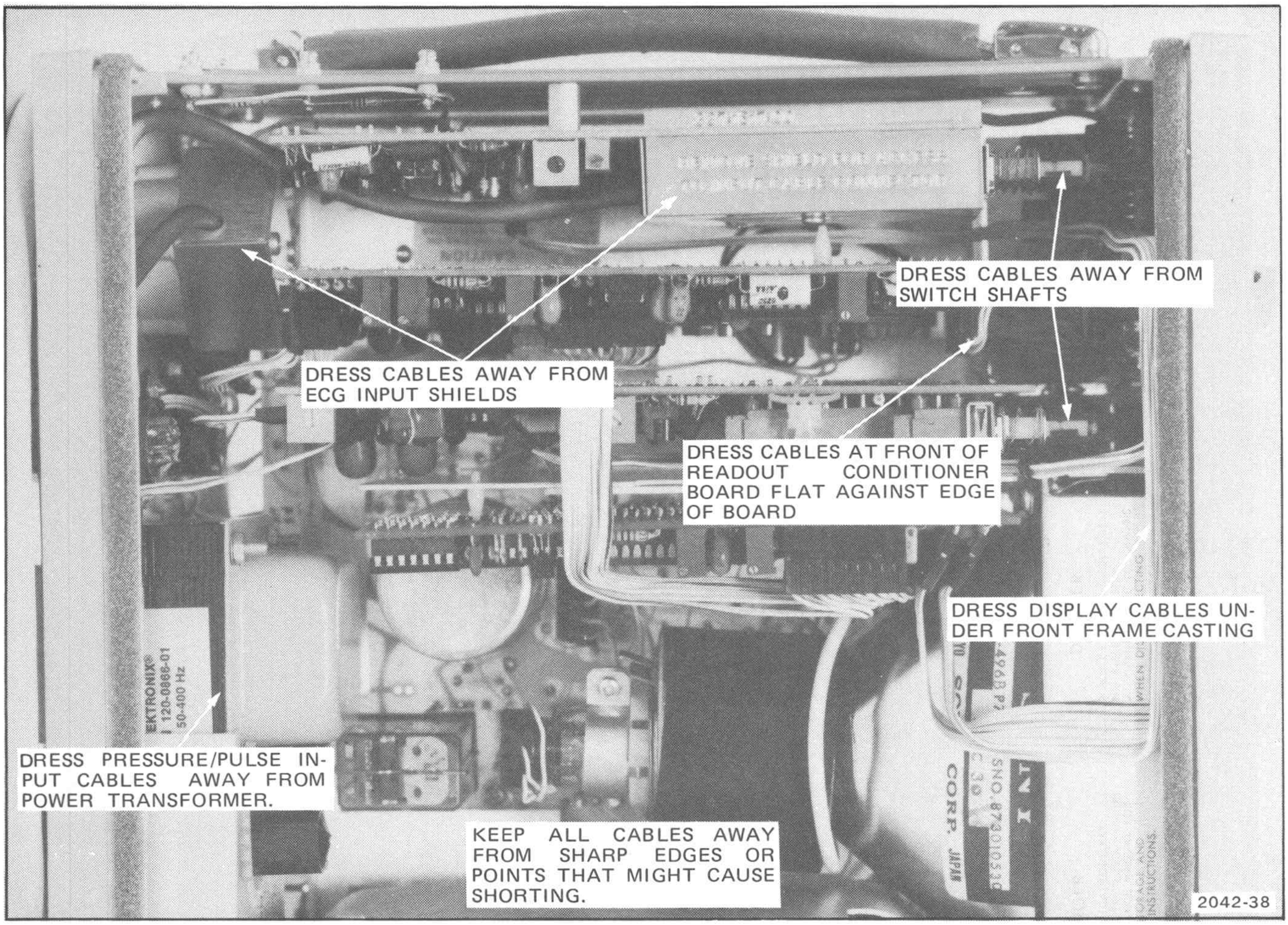


Fig. 5-10. Proper cable dress.

ABRIDGED ADJUSTMENT PROCEDURE

For adjustments and test points, see **ADJUSTMENT AND TEST POINT LOCATIONS** pullout pages.

PURPOSE

This procedure does not validate all published performance requirements. This abridged adjustment procedure is intended to permit rapid touch-up of all internal adjustments, under the assumption the monitor is functioning correctly in all respects, and that the service person is familiar with the methods described in the Check/Adjust procedure.

The procedure is divided by major functions to permit adjustment to individual circuits without having to perform a complete readjustment. However, if the −12 volt setting is changed, the entire monitor should be readjusted. When making partial adjustments, always set controls according to Preliminary Setup below.

PRELIMINARY SETUP

POWER	in (on)
DISPLAY OFF	in (off)
ECG OFF	in (off)
LOW RATE LIMIT	RATE ALARM OFF
SWEEP SPEED 100	In

Set the remaining controls as desired. Connect the monitor to the correct ac-line source.

DO NOT PRESET INTERNAL CONTROLS!

NOTE

Do not adjust the −12 V supply if it is within 25 mV unless a complete recalibration is intended.

POWER SUPPLY AND DISPLAY

1. 12 VOLTS

SETUP—Connect test DVM to point A and TP−12 V.

ADJUST—−12 Volts (R737) for −12.0 V.

2. TRACE ROTATION

SETUP—Connect test DVM to point A and TP−12 V.

ADJUST—−12 Volts (R737) for −12.0 V.

NOTE

Due to effects of earth's magnetic field, keep monitor upright when adjusting spotcentering, Horizontal Position and Horizontal Width.

3. SPOT CENTERING AND FOCUS

SETUP—Unplug yoke (P641).

ADJUST—Yoke centering rings for centered spot (at 150 mmHg and 60 BEATS/MIN marks).

ADJUST—Focus (R841) for smallest round spot.

4. HORIZONTAL POSITION

SETUP—Plug in yoke (P641).

ADJUST—Horiz Position (R671) to make trace begin at left end of graticule lines.

5. HORIZONTAL WIDTH

SET 414—ECG I, in.

SETUP—Connect function generator through low-pass filter to ECG INPUT connector. Display 4 cm, 3 Hz.

ECG

6. INPUT OFFSET NULL

SET 414—ECG I, in.

SETUP—Connect ECG shorting connector to ECG INPUT connector. Connect test oscilloscope to TP178.

ADJUST—Input Offset Null (R170) for 0.0 V.

7. DC LEVEL

SETUP—Connect test oscilloscope to ECG OUTPUT (TIP X1000) through stereo phone plug.

ADJUST—Dc Level (R185) for 0 V.

8. ECG OUTPUT GAIN

SETUP—Connect function generator to test oscilloscope and through precision attenuator to ECG INPUT connector. Apply 1.0 V, 10 Hz square wave. Note reference amplitude on test oscilloscope to ECG OUTPUT (TIP X1000).

ADJUST—Gain (R184) for output equal to reference amplitude.

DIGITAL DISPLAY

9. DVM ZERO AND DVM CAL

SET 414—ECG OFF, in (off); PRESSURE 150, in; DISPLAY OFF, in (off); MEAN, in; °C/°F, °F; POWER, out (off).

SETUP—Connect pressure transducer to PRESSURE TRANSDUCER INPUT connector. Connect test DVM to TP GND 1 and TP1012. Set POWER button in (on). Adjust ZERO control for reading between .0020 and .0010 V on test DVM, not exactly zero.

ADJUST—DVM Zero (R2334) so that 414 digital display reads one less than test DVM (rounded off to the nearest count). For example, if the test DVM reads .0023, the 414 digital display should read 1, or if the test DVM reads .0026, the 414 digital display should read 2.

SETUP—Insert 113°F temperature substitution plug (Fig. 5-3) into TEMPERATURE SENSOR INPUT jack.

ADJUST—DVM Cal (R2332) for same number on 414 display as on test DVM.

INTERACTION—Occurs between DVM Zero and DVM Cal adjustments. Repeat adjustments as needed.

10. TEMP SPAN

SET 414—POWER button out (off).

SETUP—Connect test DVM to TP GND 1 and TP1410. Set POWER button in (on).

ADJUST—Temp Span (R1410) for 1.759 V on test DVM.

11. °F CAL AND °C CAL

SETUP—Insert 77°F temperature substitution plug in TEMPERATURE SENSOR INPUT jack.

ADJUST—°F Cal (R1423) for 77.0 on digital display.

SET 414—°C/°F switch to °C.

ADJUST—°C Cal (R1422) for 25.0 on digital display.

PRESSURE/PULSE

12. GAUGE FACTOR

SET 414—PRESSURE 250, in; MEAN, in.

SETUP—Connect manometer to pressure transducer and pressure transducer to PRESSURE TRANSDUCER INPUT connector.

ADJUST—ZERO control for +0 on digital display.

SETUP—Apply 250 mmHg pressure.

ADJUST—Gauge Factor (R647) for 250 on digital display.

INTERACTION—Occurs between ZERO and Gauge Factor settings. Repeat this step as necessary to make the difference between the two settings, 250 within 1 mmHg.

13. PRESSURE POSITION AND VERTICAL SENSITIVITY

SET 414—DISPLAY OFF button out (on).

SETUP—Set ZERO control for +0 on digital display.

ADJUST—Pressure Position (R495) to make trace coincide with ZERO graticule line.

SETUP—Apply 250 mmHg pressure.

ADJUST—Vertical Sensitivity (R647) to correct one half of crt display error.

INTERACTION—Occurs between Pressure Position and Vertical Sensitivity. Repeat this step as necessary until error is eliminated.

RATE

14. RATE CAL

SET 414—ECG I, in; RATE, in; DISPLAY OFF, in (off).

SETUP—Connect function-generator through low-pass filter to ECG INPUT connector. Display 4 cm at 4 Hz (240 bpm).

ADJUST—Rate Cal (R1215) for 240 on digital display.

NOTE

ECG leakage checks should be performed after readjustment. Refer to Check/Adjust procedure.

7. DC LEVEL

SETUP—Connect test oscilloscope to ECG OUTPUT (TIP X1000) through stereo phone plug.

ADJUST—Dc Level (R185) for 0 V.

8. ECG OUTPUT GAIN

SETUP—Connect function generator to test oscilloscope and through precision attenuator to ECG INPUT connector. Apply 1.0 V, 10 Hz square wave. Note reference amplitude on test oscilloscope to ECG OUTPUT (TIP X1000).

ADJUST—Gain (R184) for output equal to reference amplitude.

DIGITAL DISPLAY

9. DVM ZERO AND DVM CAL

SET 414—ECG OFF, in (off); PRESSURE 150, in; DISPLAY OFF, in (off); MEAN, in; °C/°F, °F; POWER, out (off).

SETUP—Connect pressure transducer to PRESSURE TRANSDUCER INPUT connector. Connect test DVM to TP GND 1 and TP1012. Set POWER button in (on). Adjust ZERO control for reading between .0020 and .0010 V on test DVM, not exactly zero.

ADJUST—DVM Zero (R2334) so that 414 digital display reads one less than test DVM (rounded off to the nearest count). For example, if the test DVM reads .0023, the 414 digital display should read 1, or if the test DVM reads .0026, the 414 digital display should read 2.

SETUP—Insert 113°F temperature substitution plug (Fig. 5-3) into TEMPERATURE SENSOR INPUT jack.

ADJUST—DVM Cal (R2332) for same number on 414 display as on test DVM.

INTERACTION—Occurs between DVM Zero and DVM Cal adjustments. Repeat adjustments as needed.

10. TEMP SPAN

SET 414—POWER button out (off).

SETUP—Connect test DVM to TP GND 1 and TP1410. Set POWER button in (on).

ADJUST—Temp Span (R1410) for 1.759 V on test DVM.

11. °F CAL AND °C CAL

SETUP—Insert 77°F temperature substitution plug in TEMPERATURE SENSOR INPUT jack.

ADJUST—°F Cal (R1423) for 77.0 on digital display.

SET 414—°C/°F switch to °C.

ADJUST—°C Cal (R1422) for 25.0 on digital display.

PRESSURE/PULSE

12. GAUGE FACTOR

SET 414—PRESSURE 250, in; MEAN, in.

SETUP—Connect manometer to pressure transducer and pressure transducer to PRESSURE TRANSDUCER INPUT connector.

ADJUST—ZERO control for +0 on digital display.

SETUP—Apply 250 mmHg pressure.

ADJUST—Gauge Factor (R647) for 250 on digital display.

INTERACTION—Occurs between ZERO and Gauge Factor settings. Repeat this step as necessary to make the difference between the two settings, 250 within 1 mmHg.

13. PRESSURE POSITION AND VERTICAL SENSITIVITY

SET 414—DISPLAY OFF button out (on).

SETUP—Set ZERO control for +0 on digital display.

ADJUST—Pressure Position (R495) to make trace coincide with ZERO graticule line.

SETUP—Apply 250 mmHg pressure.

ADJUST—Vertical Sensitivity (R647) to correct one half of crt display error.

INTERACTION—Occurs between Pressure Position and Vertical Sensitivity. Repeat this step as necessary until error is eliminated.

RATE

14. RATE CAL

SET 414—ECG I, in; RATE, in; DISPLAY OFF, in (off).

SETUP—Connect function-generator through low-pass filter to ECG INPUT connector. Display 4 cm at 4 Hz (240 bpm).

ADJUST—Rate Cal (R1215) for 240 on digital display.

NOTE

ECG leakage checks should be performed after readjustment. Refer to Check/Adjust procedure.

OPTIONS

Your instrument may be equipped with one or more options. This section describes those options currently available for the 414 monitor.

OPTION 2 - EXTERNAL PRESSURE GAUGE-FACTOR ADJUSTMENT

Pressure Gauge Factor control added to rear panel to accommodate non-standard transducers.

OPTION 3 - F-CELL BATTERY PACK

F-Cell battery pack provided in place of D-Cell pack.

OPTION 4 - ECG FULL-LEAD SELECTION

Provides an 8-position rotary switch in place of the 3 ECG lead selector pushbuttons.

OPTION 10 - ELECTRO-SURGICAL INTERFERENCE SUPPRESSION

Specially designed ECG circuit enhances interpretation of the ECG waveform when electro-surgical instruments are used.

OPTION 15 - NO ACCESSORIES

Deletes all included accessories except manuals.

OPTION 20 - NO PRESSURE

Deletes blood pressure facilities leaving dual-trace capability of ECG and pulse.

OPTION 21 - DUAL PRESSURE

Provides a second pressure channel in place of the pulse channel in the standard 414 Monitor.

OPTION 3

The 414 Option 3 substitutes an F-cell battery pack for the standard D-cell battery pack.

The operation and electrical specifications of the Option 3 are the same as the standard instrument except that the Internal Battery Operating Time is changed from 1.5 hours to 3.0 hours.

414 OPTION 10

INTRODUCTION

The 414 Option 10 provides electro-surgical interference suppression. This feature greatly enhances interpretibility of the ECG waveform display when electro-surgical instruments are used.

Option 10 is basically a standard 414 with a specially designed ECG circuit. Option 10 is not available with Option 4 (Full-Lead Select).

The following pages provide specifications, operating considerations, detailed circuit description, parts list, and schematics relating to Option 10.

SPECIFICATIONS

CHARACTERISTICS AND PERFORMANCE REQUIREMENTS	SUPPLEMENTAL INFORMATION
ECG INPUT	
Self Protection	
Cautery Rejection	
Greater than 16 dB attenuation at 200 Hz.	Greater than 7 dB attenuation at 100 Hz.
TRANSFER CHARACTERISTICS	
Bandwidth	
0.2 Hz (+/-25%) to 50 Hz (+/-25%) at -3 dB points.	16 dB down at 200 Hz, 7 dB down at 100 Hz.
Trace Baseline Overshoot Following Pacer Signal	Less than 200 microvolts, referred to input.
QRS DETECTOR	
R-Wave Edge Timer	10 ms +/-2 ms.

OPERATING CONSIDERATIONS

The Tektronix 414 Option 10 Patient Monitor is designed to effectively suppress electro-surgical interference. Suppression can be enhanced by carefully placing ECG and cautery electrodes, cables, and leads, and by positioning the monitor away from the electro-surgical equipment. See Operators Manual for details.

The degree of suppression can easily be seen by comparing ECG waveforms, from the same source, simultaneously displayed on a standard monitor and an Option 10 monitor, while operating electro-surgical equipment.

ADJUSTMENTS

Make the following change to the Adjustments section.

B6. QRS TIMING

b. CHECK--Interval between first and second positive-going edges at TP382 is 10 ms, within 2 ms.

THEORY OF OPERATION

ECG Amplifier Circuit Operation

The ECG signal enters the input amplifier (Fig. 3-2) through three electrode wires. One of the wires is signal reference and the other two are used for a differential input signal. The ECG push buttons are used to select any pair of wires as the input signal.

The ECG patient cables contain a resistor in series with each input wire. These resistors and the input protection circuit protect the input amplifier during defibrillation and electrocautery.

A very small amount of current (8 nA) is injected into the patient electrodes. When this current is interrupted in any input wire, (such as when a wire breaks) the LEAD FAULT indicator lights.

The input amplifier is isolated from the other circuitry and from the monitor chassis. The shield covering the ECG input amplifier circuitry and the shield in the patient cable are connected to the floating ground point to reduce ac interference.

A floating power supply (250 kHz converter) provides the power for the Isolated Input Amplifier through transformer T155. The circuit is designed so that the amplified ECG signal varies the loading on the transformer, which causes the supply current to change. This changing current becomes an amplified voltage-signal, at the output of the Current-To-Voltage Converter, and provides signals to the QRS Detector and the Ac-Coupled Amplifier. The ac-Coupled Amplifier provides the remainder of the needed gain and determines the high and low-frequency

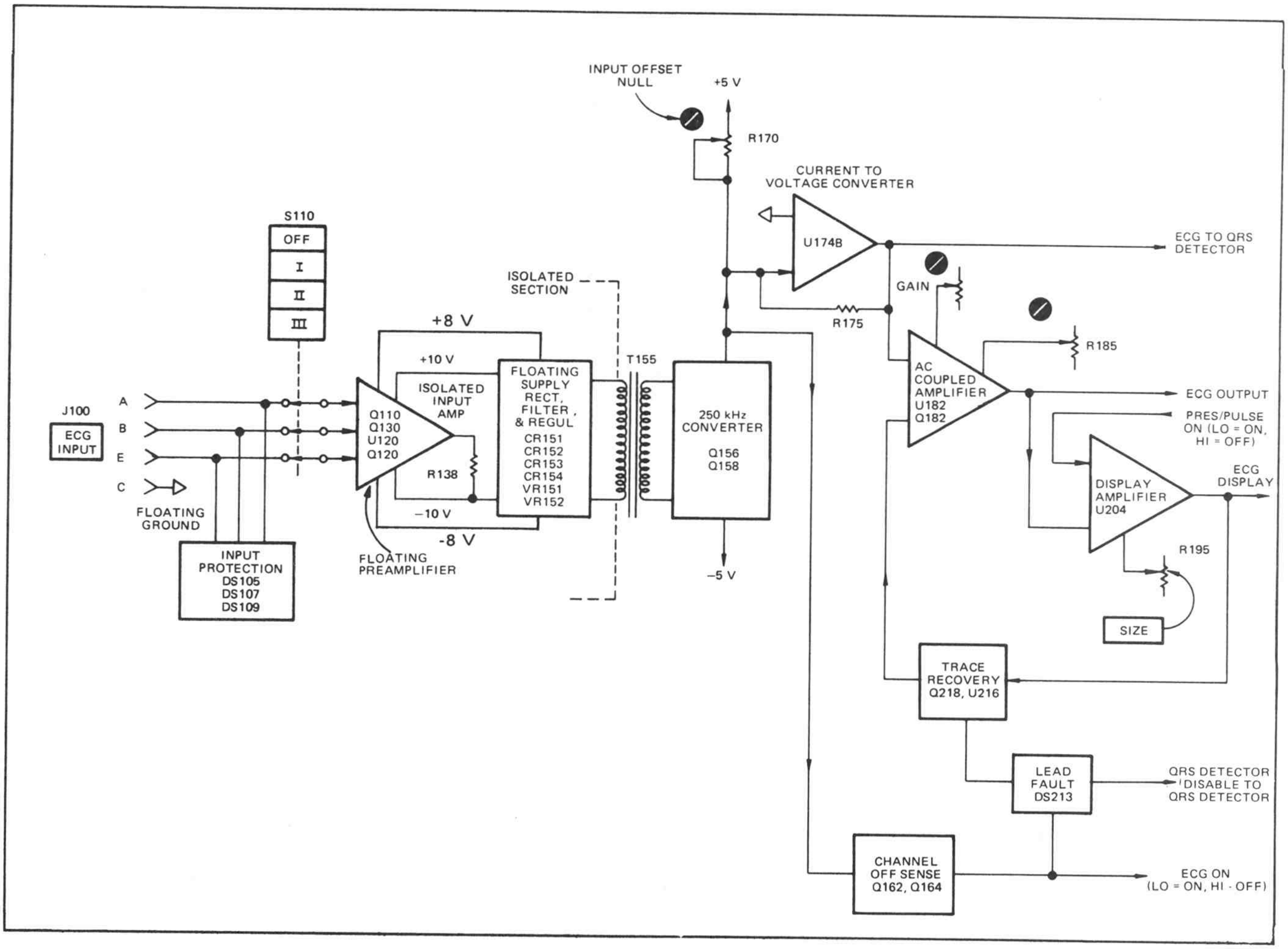


Fig. 3-2 ECG amplifier block diagram.

response of the ECG channel. Gain and dc level are set by the two calibration adjustments in this circuit. Output of this amplifier provides the ECG output to the rear panel and the input to the Display Amplifier. In the Display Amplifier, ECG-display-signal amplitude can be varied with the SIZE control. This control does not change the ECG-output signal amplitude to the rear panel. A logic signal from the Pressure/Pulse board positions the ECG-display baseline for single or dual-trace operation.

FLOATING POWER SUPPLY. This circuit consists of a converter (Q156, Q158), a transformer (T155) and a rectifier-filter-regulator circuit. The converter produces an approximate 250 kHz trapezoidal wave. The frequency is dependent upon the load on the converter. T155 is insulated for at least 5 kV.

ECG INPUT AMPLIFIER. Circuitry is provided that protects the input amplifier during electrocautery and defibrillation. Input voltage is limited by DS105, DS107, DS109, R107, R114, CR107, CR109, CR114, CR116, VR120, VR122, and the 1 k ohm resistors in the patient cable. Capacitors C105, C107, C109, and C121 reduce rf interference from TV and radio signals and electro-cauterizers. Resistors R107 and R114 also provide patient protection in case of circuit failure.

Resistors R104 and R112 supply about 8 nA to the patient electrodes. If this current is interrupted (wire breaking or high electrode resistance), the display will shift off screen and the LEAD FAULT indicator will light.

The input amplifier is a differential-input, single-ended-output circuit consisting of balanced pair Q110A and Q110B, output amplifier U120B, and Q120. The output of Q120 varies the current through R138 in proportion to the ECG-input signal. The differential gain of the amplifier is determined by feedback dividers R136/R133 and R117/R130. The gain up to TP136 is about 23.6 times the input signal. U120A maintains the junction of R130 and R133 at 0 volts (referenced to the floating ground), which permits R127 to set a constant current through Q110A and Q110B. U120A also provides negative feedback through the reference wire and the patient to Q110A and Q110B, which reduces the ac common-mode signals to a very low level.

When no signal is applied there should be about 0 volts at TP136 and at the junction of R130 and R133. Under this condition, R138 current is about 5 mA.

R138 current comes from the +10 V supply, through Q120 and to the −10 V supply. When a signal enters the input amplifier, the current through R138 increases or decreases which changes the load on the 250 kHz Converter.

CURRENT TO VOLTAGE CONVERTER. Feedback action of U174B maintains 0 volts at TP170, by way of R175 and R170. Input Offset Null is adjusted so that TP178 is 0 volts when no signal is applied to the ECG INPUT. The ECG input signal thus varies the current in the 250 kHz Converter. Since the current through R170 and R172 is constant, the current through R175 will change. The changing current in R175 is produced by a voltage at the output of U174B which is 50 times the ECG input signal. The gain is determined by the Isolated Input Amplifier gain up to TP136, the turns ratio of T155, and the ratio of R175 to R138.

R178 and C178 filter most of the inverter hash from the signal. Remaining hash is removed by the Ac-Coupled Amplifier.

AC COUPLED AMPLIFIER. U182 and its associated circuitry make up a special form of non-inverting amplifier with upper and lower bandwidth limits. Short-duration overdrive signals will not shift the display baseline significantly because ac-coupling capacitor C181 is in the feedback circuit.

The X20 amplifier gain is determined by R179, R181, R183, R184 (Gain), and R186. High-frequency bandwidth is determined by R179, R181, and C179. Low-frequency bandwidth is determined by C181, and R219.

Resistors R179 and R181 limit the input dynamic range of the amplifier to +/-7.5 V, corresponding to a +/-150 mV dc offset at the ECG INPUT connector. This allows the LEAD FAULT indicator to be on when the input dc offset exceeds the +/-150 mV limit.

DISPLAY AMPLIFIER. The X1000 ECG signal from pin 1 of U182A goes to the Display amplifier, which consists of U204A and U204B. U204B is an inverting operational amplifier with R193, R195, and R196 making up the gain- determining divider. The SIZE control, R195, varies the gain approximately from X1/3 to X3 with X1 gain at R195 mechanical center.

U204A is an inverting operational amplifier with a gain of 1/2. R199 and R200 set the dc level of the ECG signal depending upon the status of the pressure/pulse channel as detected at the cathode of CR200.

TRACE RECOVERY CIRCUIT. The Trace Recovery circuit speeds up the return of an off-screen signal. When the dc level at pin 1 of U204A exceeds +/-1.0 V (corresponding to +/-4 cm on the screen), Q218 conducts, shunting R217 across R219 to speed up the charging of C181 in the Ac-Coupled Amplifier.

U216A, CR208, and CR205 act as a full-wave rectifier so that Q218 will turn on regardless of the polarity at pin 1 of U204A. Capacitor C212 delays Q218 turn-on so that short duration overdrive signals (such a pacer signals) will not affect the Q218 and lead-fault circuits. C212 also delays Q218 turnoff to allow the recovery action to return trace to its quiescent level.

LEAD FAULT. When the ECG input dc offset exceeds about +/-150 mV, the LEAD FAULT light-emitting diode DS213 lights. The current, through DS213, is limited to 10 mA by CR215, CR216, and R215 and feedback action of U216B. When the ECG channel is off, a positive signal through CR213 keeps DS213 turned off. A signal from CR216 anode disables the QRS detector when DS213 is on. CHANNEL OFF SENSE. This circuit consists of

Q162 and Q164 which provides a logic signal to indicate whether the ECG channel is on or off.

When the ECG channel is off, the voltage at the base of Q162 is positive, which produces a 7 volt HI signal at the collector Q164. This HI (off) signal keeps the LEAD FAULT light off and also goes to the pressure/pulse and the main boards to establish single trace conditions (when the pressure/pulse channel is on).

+5 V AND -5 V POWER SUPPLY. These regulated supplies provide power to the 250 kHz Converter and Input Offset circuitry. The +5 V regulating circuit, Q232, Q234, and VR235, is referenced to the -12 V supply. The -5 V regulating circuit is then referenced to the regulated +5 V supply.

QRS Detector Circuit Operation

The QRS Detector (Fig. 3-3) evaluates the content of the incoming ECG signal to determine when the QRS portion of the waveform occurs. The QRS segment has at least one slope which has a greater rate of voltage change for a longer period of time than other segments of the ECG waveform. When a QRS segment is detected, an ECG trigger pulse is generated that triggers the sweep and heart-rate beat tone, and supplies rate information to the rate-limit alarm circuits and digital readout.

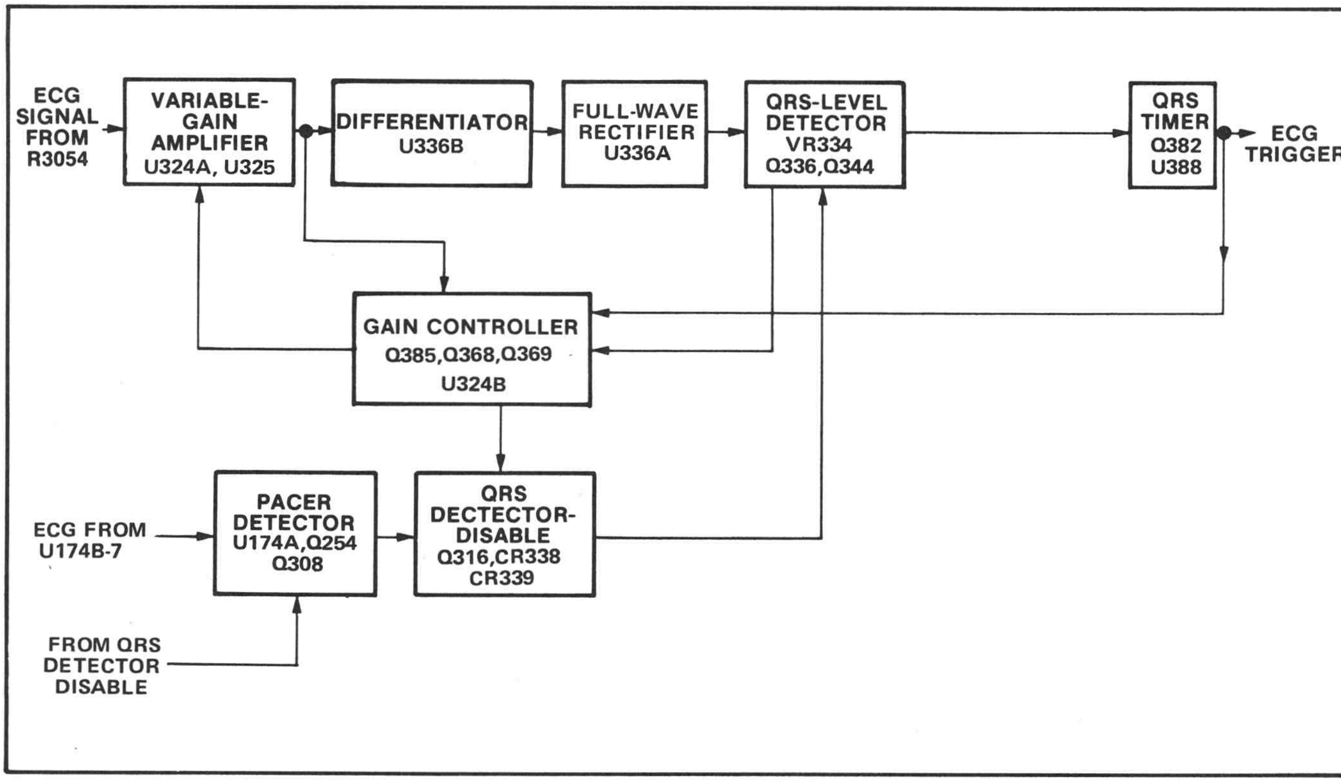


Fig. 3-3 QRS detector block diagram.

The ECG signal passes through the Variable Gain Amplifier, the Differentiator, and the Full-Wave Rectifier (absolute-value-detector). The resulting positive signal contains one or more large, relatively wide, essentially sinusoidal pulses for each QRS segment at the input. Feedback through the Automatic-Gain Control circuit maintains pulse amplitude at about 3-4 volts at TP333.

Those portions of the pulses over 1 volt pass through the QRS Level Detector to the QRS Timer. The first pulse greater than 10 ms that enters the QRS Timer circuit produces the ECG Trigger. Any other input pulses (i.e., pulses caused by T-waves) which occur during the 150 ms after the first pulse, are ignored.

The Pacer Detector circuit prevents pacer signals from producing a QRS trigger signal by shutting off the ECG signal in the QRS Level Detector circuit during the pacer pulse. Lead Fault and ECG Off signals also prevent ECG trigger.

AUTOMATIC GAIN CONTROL (AGC). The automatic gain control consists of a Variable Gain Amplifier and Gain Controller.

Variable Gain Amplifier--U324A is a non-inverting operational amplifier. Variable-gain feedback is provided through the operational transconductance amplifier U330. The gain of the operational transconductance amplifier circuit varies in direct proportion to the current into pin 5 (from 3 to 300 uA) and the value of R316. A current of 300 uA into pin 5 sets the gain of U330 to 100, and the overall gain of the Variable-Gain Amplifier to 1 (note the 100 to 1 Divider between U324A-1 and U330-3). A current of 3 uA into pin 5 sets the gain of U330 to 1 and the overall gain to 100.

The combination of R316/C323/C322 provides a low-frequency rolloff of about 1 Hz.

GAIN CONTROLLER. The Gain Controller circuit holds the pulse amplitude at TP333 at about 3-4 volts.

In the quiescent state, R339 tries to pull the emitter of Q336 to +3.7 V. However, CR335 clamps the emitter of Q336 at 0.7 V more positive than the voltage on TP333.

When a pulse on TP 333 exceeds +3 V, CR335 becomes reverse biased and Q336 turns on allowing C367 to charge through R339. The voltage on C367 sets the bias on Q368 and determines the dc current supplied to pin 5 of U330 through common base amplifier Q369 (see Variable Gain Amplifier). Increasing the charge on C367 increases the current supplied to U330-5 and reduces the gain of the Variable-Gain Amplifier.

If a QRS signal is not present for several seconds, pin 3 of U388 remains LO and cuts off Q385 long enough for C331 to charge and turn on CR331. This quickly discharges C367 through CR331 and R389. The decreased charge on C367 reduces the current through Q368 and Q369 and to U330 pin 5, increasing the gain of the Variable Gain Amplifier to maximum. When the QRS signal returns, the resulting pulses at TP333 may exceed 8.8 V causing CR334 to conduct. This rapidly charges C367 through R334 and Q336 to rapidly reduce the gain to normal. When the ECG signal at TP322 exceeds +/-7 volts, pin 7 of U324B goes HI and supplies current to U330-5 through CR324, R343, and common base amplifier Q369. This decreases the gain of the Variable Gain Amplifier. The increased current in U330-5 also provides greater current output from U330 to rapidly charge C322-C323 to accommodate any dc level changes at TP322. C310 maintains the above action long enough for TP322 to recover a stable baseline level.

DIFFERENTIATOR AND ABSOLUTE VALUE DETECTOR. Signals from the Variable Gain Amplifier at TP322 are differentiated and inverted through U336B. The differentiated signal is then full-wave rectified through CR322 for the rising portion and through U336A (X1 inverting amplifier) and CR333 for the falling portion. This full-wave rectifier action produces a positive-going pulse at TP333 for each pulse transition at TP322. This results in two positive-going pulses at TP333 for each pulse at TP322 regardless of the polarity of the pulse at TP322.

QRS TIMER. In the quiescent state, R346 tries to pull the emitter of Q344 to +1.7 V. However CR336 clamps it at 0.7 volts above the voltage on TP333. While the voltage on TP333 is less than +1 V, Q344 is off and Q382 is saturated. When the voltage on TP333 exceeds +1 V, CR336 becomes reverse biased and Q344 turns on, turning off Q382. When Q382 is turned off, C382 starts charging toward -7 volts. After about 10 milliseconds, pin 2 of U388 reaches the lower threshold point of U388 (-2.3 V), causing pin 3 to go HI to produce the ECG Trigger. When U388 switches, pin 7 is released and C388 starts charging towards +7 Volts. When pin 6 of U388 reaches the upper threshold point (about +2.3 V), pin 3 goes LO. the ECG trigger pulse at TP388 has a duration of about 150 ms.

QRS DETECTOR DISABLE. When the QRS signal exceeds +/-7 volts at TP322 and pin 7 of U324B goes HI, C310 charges, CR325 turns on, and CR315 turns off. This allows the +7 volts at R315 to turn on Q316, and pull the cathodes of CR338 and CR339 below 1 V, thus disabling the QRS Detector. A HI signal through CR313 or CR314, due to a lead fault or the channel being off, also causes Q316 to turn on and disable the QRS Detector. A HI pulse from the Pacer Detector momentarily turns on Q316 to disable the QRS Detector during a pacer signal.

PACER DETECTOR. This circuit keeps pacer signals from entering the Gain Controller and QRS Timer circuits. U174A is a differentiator with limited upper bandwidth. A pacer pulse at the input to C303 produces an output at pin 1 of U174A. When the pulse at pin 1 exceeds or equals +/-5 V, a negative output at the collector of Absolute Value Detector (Q254) triggers Q308 into conduction. This action discharges C315 in the positive direction, which causes Q316 to saturate and pull the cathodes of CR338 and CR339 below 1 volt. This clamps the Q336 and Q344 emitters below 1 volt to lock out signals to the Gain Controller and QRS Timer circuits for the duration of the Pacer Detector output pulse (about 50 ms).

The Absolute Value Detector (Q254) provides negative pulse at its collector for positive or negative pulses at its base. If U174A-1 goes to +12 V, Q254 is turned off and its collector is pulled to -12 V through R306. If U174A-1 goes to -12 V, base collector junction of Q254 is forward biased pulling its collector to about -11.3 V.

REPLACEABLE ELECTRICAL PARTS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:						
A1	670-7163-00			CKT BOARD ASSY:ECG	80009	670-7163-00
C156	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C328	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C367	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C389	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
Q110	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
Q162	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
Q164	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
Q232	151-0301-01			TRANSISTOR:SILICON,PNP,SEL	80009	151-0301-01
Q234	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
Q236	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
Q254	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
Q316	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
Q336	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
Q344	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
Q382	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
R104	302-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.50W	01121	EB1011
R112	302-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.50W	01121	EB1011
R179	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R181	321-0244-00			RES.,FXD,FILM:3.4K OHM,1%,0.125W	91637	MFF1816G34000F
R185	311-1860-00			RES.,VAR,NONWIR:TRMR,10K OHM,0.50W	32997	3299X-R27-103
R328	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R338	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R367	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R381	315-0245-00			RES.,FXD,CMPSN:2.4M OHM,5%,0.25W	01121	CB2455
U120	156-0853-02			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	04713	MLM358U
U174	156-0853-02			MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	04713	MLM358U
U182	156-1291-00			MICROCIRCUIT,LI:OPERATIONAL AMPL,JFET INPUT	01295	TL062CP/PEP 3
U204	156-0158-07			MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	80009	156-0158-07
U216	156-0158-07			MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	80009	156-0158-07
U324	156-0158-07			MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	80009	156-0158-07
U336	156-0158-07			MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	80009	156-0158-07
U338	156-0402-03			MICROCIRCUIT,LI:TIMER,TESTED	80009	156-0402-03

REPLACEABLE ELECTRICAL PARTS

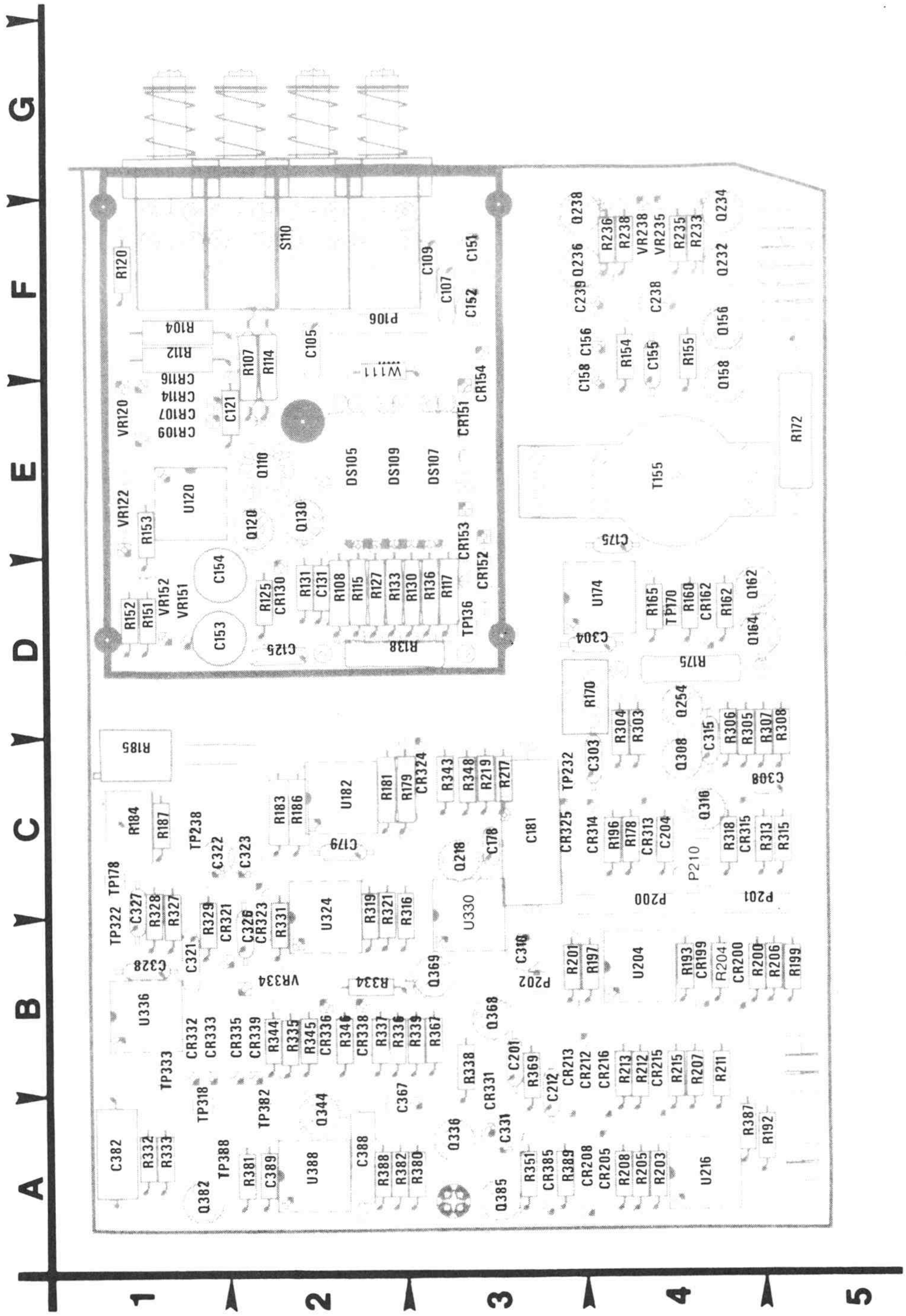
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
REMOVE:						
C212	283-0212-00			CAP.,FXD,CER DI:2UF,20%,50V	72982	8141N00425U205M
C324	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C325	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C373	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C384	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR366	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR367	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR384	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q182	151-1049-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1049-00
Q366	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q372	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
Q384	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q386	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
R188	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R189	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R322	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R323	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R324	307-1025-00			OPT ISOLATOR:500 OHM AT 40MA	18178	VTL-2C2
R325	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R326	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R364	316-0565-00			RES.,FXD,CMPSN:5.6M OHM,10%,0.25W	01121	CB5651
R365	315-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,0.25W	01121	CB7555
R366	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R368	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R372	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R383	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R384	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
R385	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R386	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255

REPLACEABLE ELECTRICAL PARTS

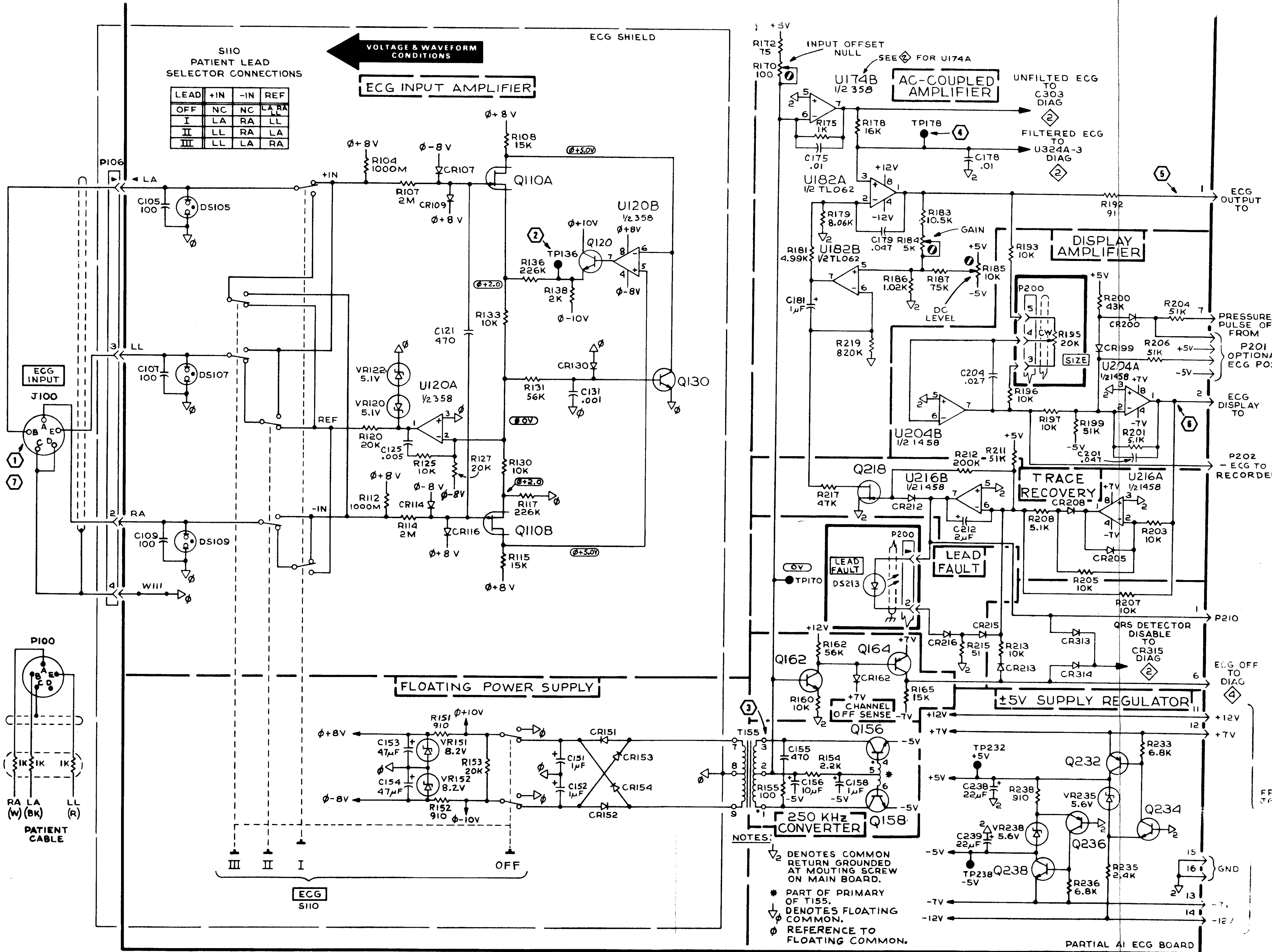
Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
ADD:						
C111	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075E474M
C121	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C131	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
C153	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	16U-47V-T
C154	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	16U-47V-T
C175	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C201	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C204	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
C310	290-0536-01			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C321	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C322	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C323	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C326	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C331	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
CR321	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR323	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR325	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR331	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR385	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q120	151-0190-05			TRANSISTOR:SILICON,NPN	80009	151-0190-05
Q369	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
Q385	151-0188-03			TRANSISTOR:SILICON,PNP,SEL	80009	151-0188-03
R111	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
R131	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R151	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R152	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R153	315-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R204	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R206	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R316	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R319	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R321	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R329	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R331	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R343	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R348	315-0185-00			RES.,FXD,CMPSN:1.8M OHM,5%,0.25W	01121	CB1855
R351	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R369	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R380	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R389	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
U330	156-0912-01			MICROCIRCUIT,LI:OPNL AMPL,SCREENED	02735	CA3080EX
VR151	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20
VR152	152-0217-00			SEMICOND DEVICE:ZENER,0.4W,8.2V,5%	04713	SZG20

REPLACEABLE MECHANICAL PARTS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:							
	131-0589-00			10	TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	136-0727-00			9	SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
ADD:							
	136-0252-07			6	SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	214-0579-00			10	TERM,TEST POINT:BRS CD PL	80009	214-0579-00
REMOVE:							
	366-1495-00			6	KNOB:GRAY	80009	366-1495-00

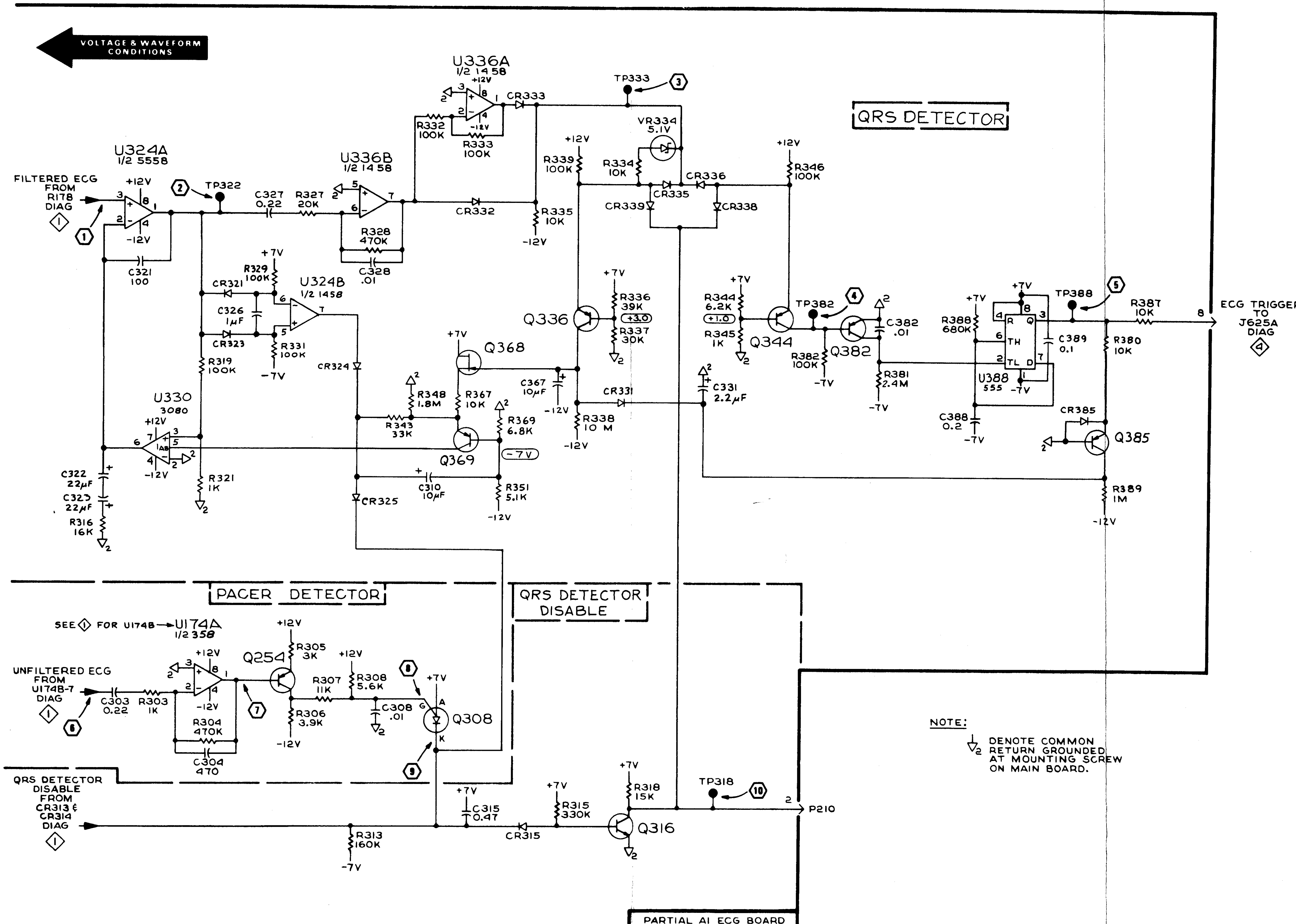

A
B
C
D
E
F
G
1
2
3
4
5

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C105	F2	CR107	E1	P105	F2	R130	D3	R219	C3	S110	F2
C107	F3	CR109	E1	P200-		R131	D2	R233	F4	S110	F2
C109	F3	CR114	E1	1,2	C3	R133	D2	R235	F4		
C121	E2	CR116	E1	P200-		R136	D3	R236	F4	T155	E4
C125	D2	CR130	D2	3,4,5	C4	R138	D2	R238	F4		
C131	D2	CR151	E3	P201	C4	R151	D1	R303	D4	TP136	D3
C151	F3	CR152	D3	P202	B3	R152	D1	R304	D4	TP170	D4
C152	F3	CR153	E3	P210	C4	R153	E1	R305	D4	TP178	C1
C153	D1	CR154	E3			R154	F4	R306	D4	TP232	C3
C154	D1	CR162	D4	Q110A	E2	R155	F4	R307	D4	TP238	C1
C155	F4	CR199	B4	Q110B	E2	R160	D4	R308	D5	TP318	A1
C156	F4	CR200	B4	Q120	E2	R162	D4	R313	C4	TP322	B1
C158	E4	CR205	A4	Q130	E2	R165	D4	R315	C5	TP333	B1
C175	E4	CR208	A3	Q156	F4	R170	D4	R316	C2	TP382	A2
C178	C3	CR212	B3	Q158	E4	R172	E5	R318	C4	TP388	A1
C179	C2	CR213	B3	Q162	D4	R175	D4	R319	C2		
C181	C3	CR215	B4	Q164	D4	R178	C4	R321	C2	U120A	E1
C201	B3	CR216	B4	Q218	C3	R179	C2	R327	C1	U120B	E1
C204	C4	CR313	C4	Q232	F4	R181	C2	R328	C1	U174A	D4
C212	B3	CR314	C4	Q234	F4	R183	C2	R329	B1	U174B	D4
C238	F4	CR315	C4	Q236	F3	R184	C1	R331	B2	U182A	C2
C239	F3	CR321	B1	Q238	F3	R185	C1	R332	A1	U182B	C2
C303	C4	CR323	B2	Q254	D4	R186	C2	R333	A1	U204A	B4
C304	D4	CR324	C3	Q308	C4	R187	C1	R334	B2	U204B	B4
C308	C5	CR325	C3	Q316	C4	R192	A4	R335	B2	U216A	A4
C310	B3	CR331	A3	Q336	A3	R193	B4	R336	B2	U216B	A4
C315	C4	CR332	B1	Q344	A2	R196	C4	R337	B2	U324A	C2
C321	B1	CR333	B1	Q368	B3	R197	B4	R338	B3	U324B	C2
C322	C1	CR335	B1	Q369	B3	R199	B5	R339	B3	U330	C3
C323	C2			Q382	A1	R200	B4	R343	C3	U336A	B1
C326	B2	CR338	B2	Q385	A3	R201	B3	R344	B2	U336B	B1
C327	C1	CR339	B2			R203	A4	R345	B2	U388	A2
C328	B1	CR385	A3	R104	F1	R204	B4	R346	B2		
C331	A3			R107	F2	R205	A4	R348	C3	VR120	E1
C367	A2	DS105	E2	R108	D2	R206	B5	R351	A3	VR122	E1
C382	A1	DS107	E3	R112	F1	R207	B4	R367	B3	VR151	D1
C388	A2	DS109	E2	R114	F2	R208	A4	R369	B3	VR152	D1
C389	A2			R115	D2	R211	B4	R380	A3	VR235	F4
				R117	D3	R212	B4	R381	A2	VR238	F4
				R120	F1	R213	B4	R382	A2	VR334	B2
				R125	D2	R215	B4	R387	A4		
				R127	D2	R217	C3	R388	A2	W111	F2
								R389	A3		


S110
PATIENT LEAD
SELECTOR CONNECTIONS

LEAD	+IN	-IN	REF
OFF	NC	NC	LA RA LL
I	LA	RA	LL
II	LL	RA	LA
III	LL	LA	RA

VOLTAGE & WAVEFORM CONDITIONS
ECG SHIELD
ECG INPUT AMPLIFIER
ECG INPUT
J100
P106
P100
PATIENT CABLE
RA (W)
LA (BK)
LL (R)
FLOATING POWER SUPPLY
ECG S110
INPUT OFFSET NULL
SEE ② FOR U174A
U174B 1/2 358
AC-COUPLED AMPLIFIER
UNFILTED ECG TO C303 DIAG ②
FILTERED ECG TO U324A-3 DIAG ②
U182A 1/2 TL062
U182B 1/2 TL062
GAIN
DC LEVEL
DISPLAY AMPLIFIER
SIZE
U204A 1/2 1458
U204B 1/2 1458
ECG OUTPUT TO
PRESSURE/ PULSE OFF FROM
P201 OPTIONAL ECG POS
ECG DISPLAY TO
P202 - ECG TO RECORDER
J625A DIAG ④
TRACE RECOVERY
U216A 1/2 1458
U216B 1/2 1458
LEAD FAULT
QRS DETECTOR DISABLE TO CR315 DIAG ②
P210
ECG OFF TO DIAG ④
+7V CHANNEL OFF SENSE
±5V SUPPLY REGULATOR
250 KHz CONVERTER
NOTES:
DENOTES COMMON RETURN GROUNDED AT MOUTING SCREW ON MAIN BOARD.
* PART OF PRIMARY OF T155.
DENOTES FLOATING COMMON.
ϕ REFERENCE TO FLOATING COMMON.
PARTIAL A1 ECG BOARD


VOLTAGE & WAVEFORM CONDITIONS
QRS DETECTOR
U324A 1/2 5558
U336A 1/2 1458
U336B 1/2 1458
U324B 1/2 1458
U330 3080
U388 555
FILTERED ECG FROM R178 DIAG
TP322
TP333
TP382
TP388
TP318
ECG TRIGGER TO J625A DIAG
PACER DETECTOR
QRS DETECTOR DISABLE
SEE ◇ FOR U174B → U174A 1/2 358
UNFILTERED ECG FROM U174B-7 DIAG
QRS DETECTOR DISABLE FROM CR313 & CR314 DIAG
P210
PARTIAL A1 ECG BOARD
NOTE:
DENOTE COMMON RETURN GROUNDED AT MOUNTING SCREW ON MAIN BOARD.

414 OPTION 20

The 414 Option 20 is a dual-trace monitor for simultaneous display of Pulse and ECG waveforms.

The 414 Option 20 monitor is the same as the standard 414 except that the pressure measurement capability, rear-panel signal outputs, and rear-panel °F/°C switches have been deleted. The ± module of the readout is also deleted.

The operation and Electrical Specifications of the Pulse and ECG functions are the same as for the standard 414 monitor. The temperature readout is in °C only.

GENERAL INFORMATION

SPECIFICATIONS

All Electrical Characteristics and Performance Requirements remain unchanged from the standard 414 monitor except for the following:

1. All references to output signals are deleted.

2. All references to Pressure measurement are deleted.

3. All references to °F temperature measurement are deleted.

4. All references to − (negative) digital readout are deleted.

5. The lower limit of the temperature readout range is changed from −5°C to +5°C. (The display flashes, indicating an overrange condition, if the temperature is below approximately +2.5°C or above approximately +47.5°C.)

ADJUSTMENTS

CHECK/ADJUST PROCEDURE

Perform the Check/Adjust procedure as written in the 414 Service manual except as noted below:

Perform all preliminary procedures as written.

A. POWER SUPPLY AND DISPLAY

Perform as written.

B. ECG

Delete "3. Stereo phone plug (Fig. 5-1c)" from the Equipment Required List.

B1. INPUT OFFSET NULL

Perform as written.

B2. DC LEVEL

a. CHECK—Trace is vertically centered within 3 mm.

b. ADJUST—DC level (R185) for vertically centered trace.

c. Remove ECG shorting plug.

B3 ECG OUTPUT GAIN

Delete.

B4 through B8

Perform as written.

C. DIGITAL DISPLAY

C1. DVM ZERO AND DVM CAL

a. SET: ECG OFF in (off)

DISPLAY OFF in (off)

TEMP in

POWER Out (off)

b. Insert a 5°C temperature sensor substitution plug into TEMPERATURE SENSOR INPUT jack on rear panel.

c. and d. Perform as written.

e. Adjust the °C Cal (R1420) for a reading between 0.0020 V and 0.0100 V on test DVM. Do not attempt to set for 0.0000 V.

f. Delete.

g. and h. Perform as written.

i. Remove 5°C temperature sensor substitution plug.

j. Change "113°F" to "45°C".

k. and l. Perform as written.

m. Remove 45°C temperature sensor substitution plug and insert the 5°C temperature sensor substitution plug.

n. Perform as written.

o. Re-adjust °C Cal (R1420) for display of 5.0 and remove 5°C temperature sensor substitution plug and test DVM.

D. TEMPERATURE

D1. TEMP SPAN

a. Delete "°C/°F °F".

b. through e. Perform as written.

D2. Degree C CAL

a. Change "77°F" to "25°C" (Table 1 of this option is used in lieu of Table 5-3).

b. and c. Perform as written.

E. PRESSURE/PULSE

Delete "1. Manometer", "2. Pressure Transducer", and "4. Stereo phone plug (Fig. 5-1A)" from Equipment Required List.

E1. through E4

Delete

E5. and E6

Perform as written.

F. RATE

Perform as written.

G. ECG LEAKAGE AND COMMON MODE REJECTION RATIO (CMRR)

Perform as written.

Option 20, Table 1

Temperature Readout Check and Adjustment

Temperature Sensor Substitution Plug (Fig. 5-1D)	414 Digital Display	Check/Adjust
25°C	25.0 ±0	Check
25°C	25.0 ±0	Adjust °C Cal (R1420)
5°C	5.0 ±0.1	Check
45°C	45.0 ±0.1	Check

ABRIDGED ADJUSTMENT PROCEDURE

1. through 6.

Perform as written.

7. and 8.

Delete.

9. DVM ZERO AND DVM CAL

SET 414—ECG OFF, in (off); DISPLAY OFF, in(off); TEMP, in; POWER out, (off).

SETUP—Insert 5°C temperature sensor substitution plug into rear-panel TEMPERATURE SENSOR INPUT jack. Connect test DVM to TPGND1 and TP1012. Set POWER button in (on). Adjust °C Cal (R1420) for test DVM reading between 0.0020 V and 0.100 V.

ADJUST—DVM Zero (R2334) so that display reads one number less than test DVM rounded off to nearest millivolt. Re-adjust °C Cal (R1420) for display of 5.0.

SETUP—Remove 5°C temperature sensor substitution plug and insert 45°C temperature sensor substitution plug.

ADJUST—DVM Cal (R2332) for same display as test DVM rounded off to nearest millivolt.

INTERACTION—Occurs between DVM Zero and DVM Cal adjustments. Repeat adjustments as needed.

10. TEMP SPAN

Perform as written.

11. °C Cal

SETUP—Insert a 25°C temperature sensor substitution plug in the rear-panel TEMPERATURE SENSOR INPUT jack.

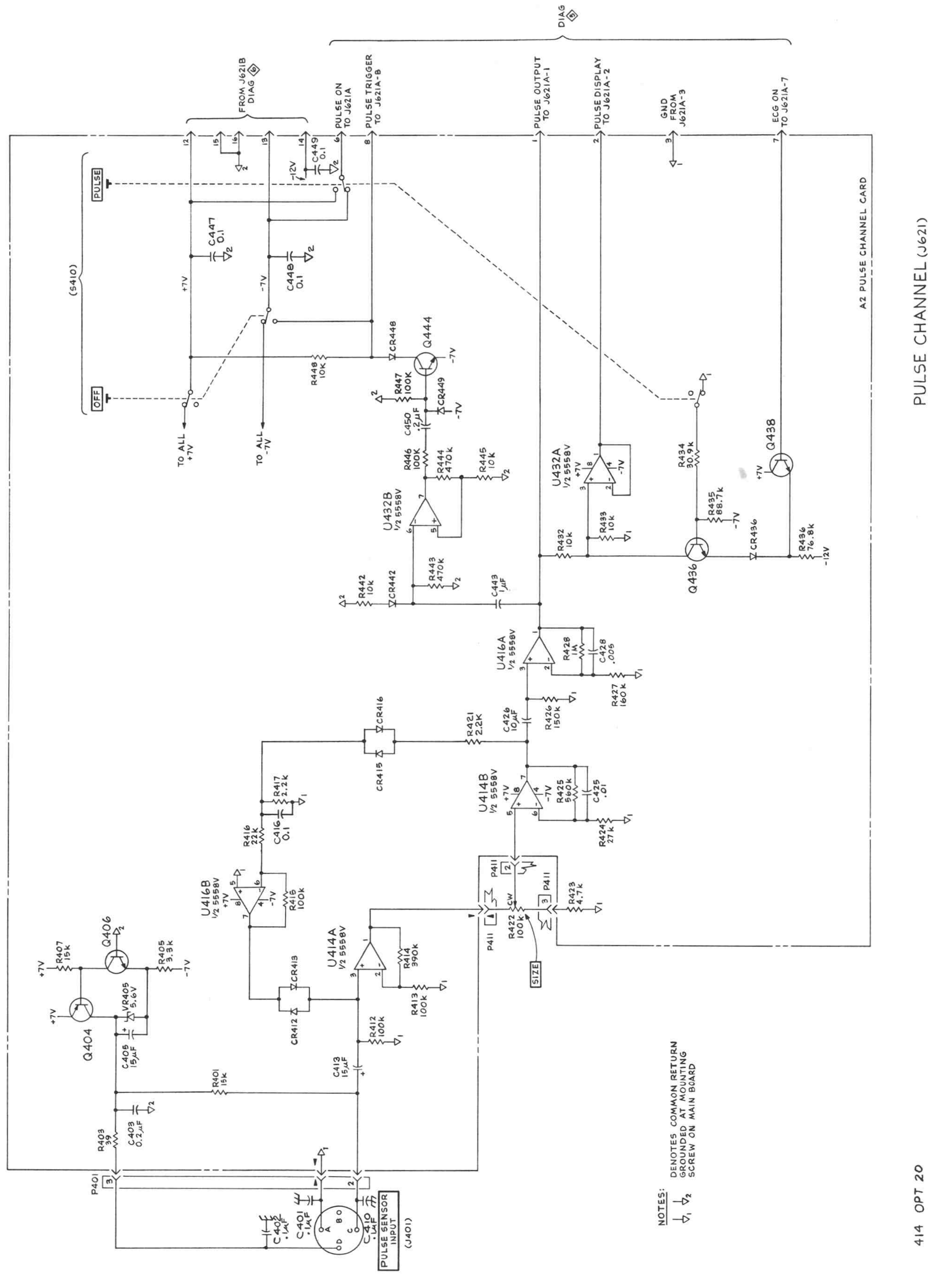
ADJUST—°C Cal (R1420) for 25.0 on digital display.

12. and 13.

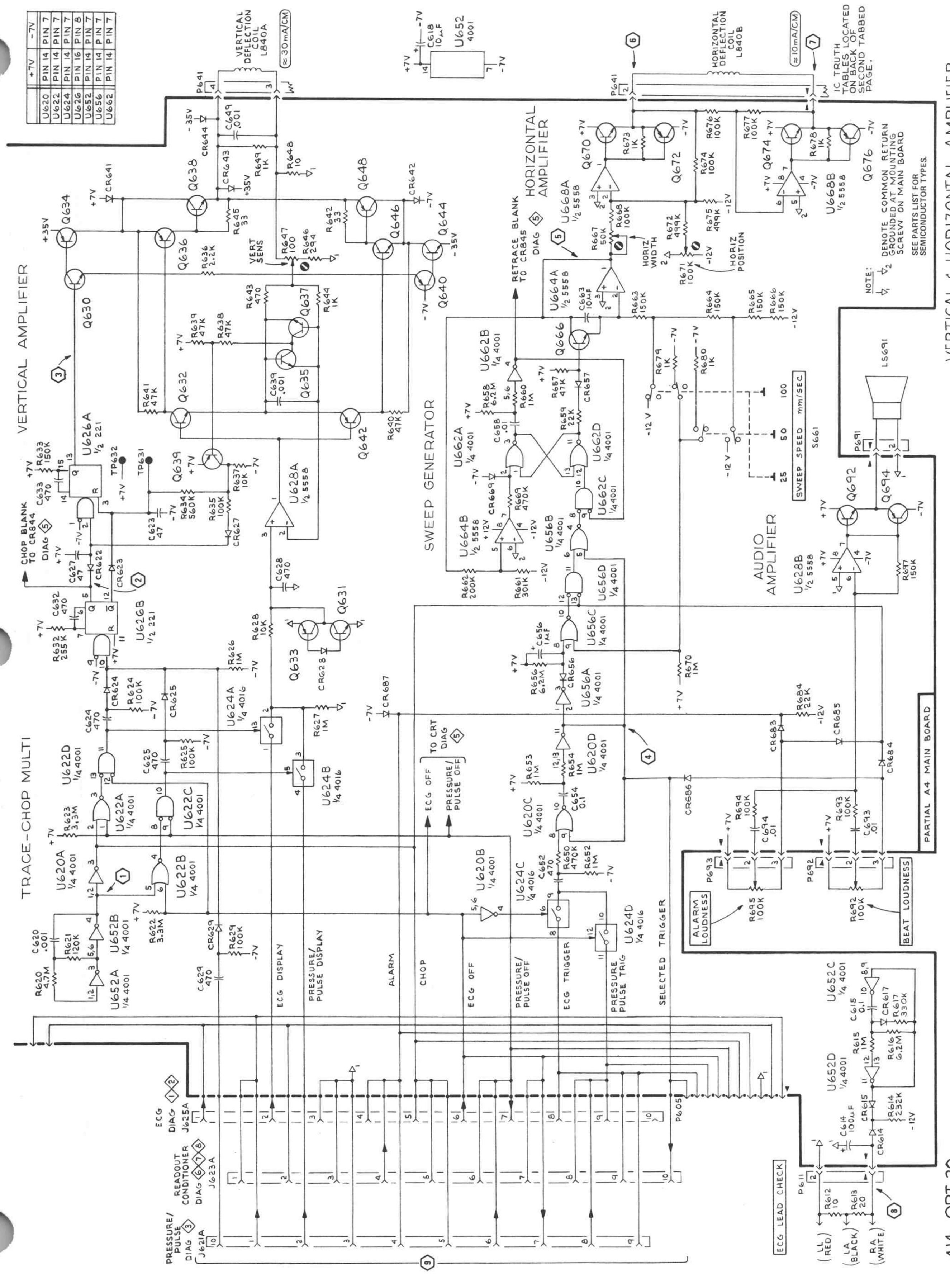
Delete.

14. RATE CAL

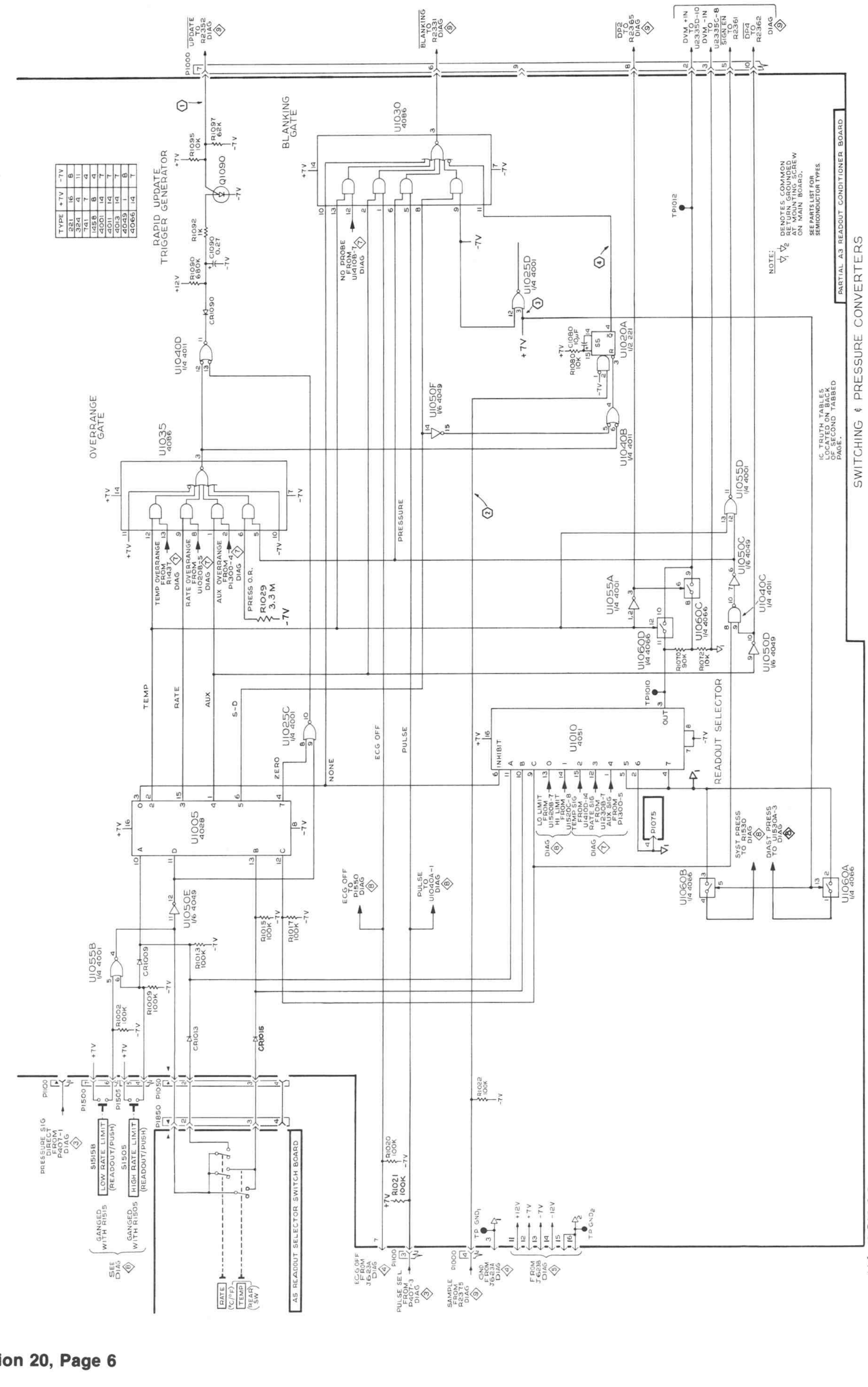
Perform as written.



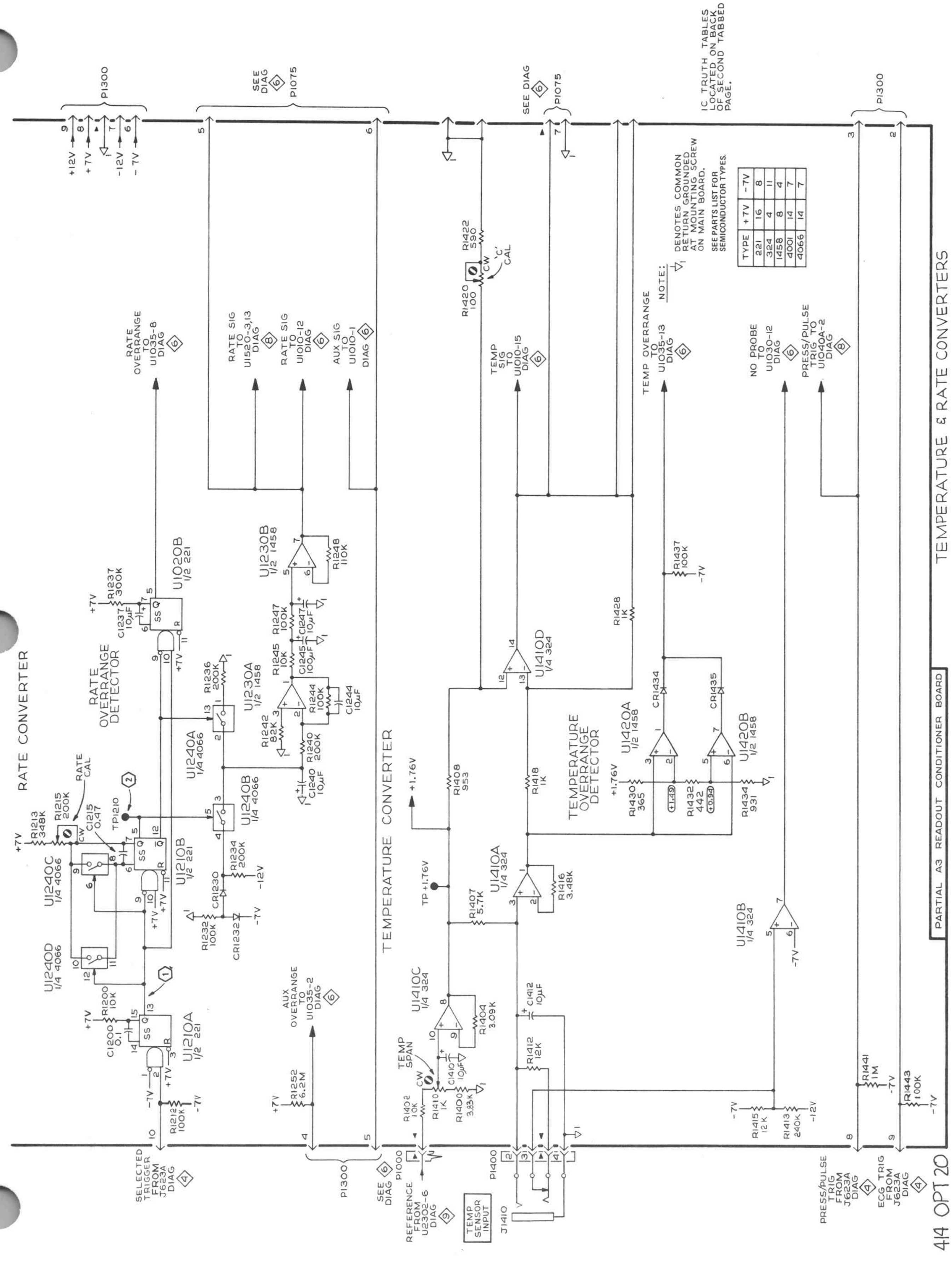
Opt. 20, Fig. 1. Pulse channel diagram.



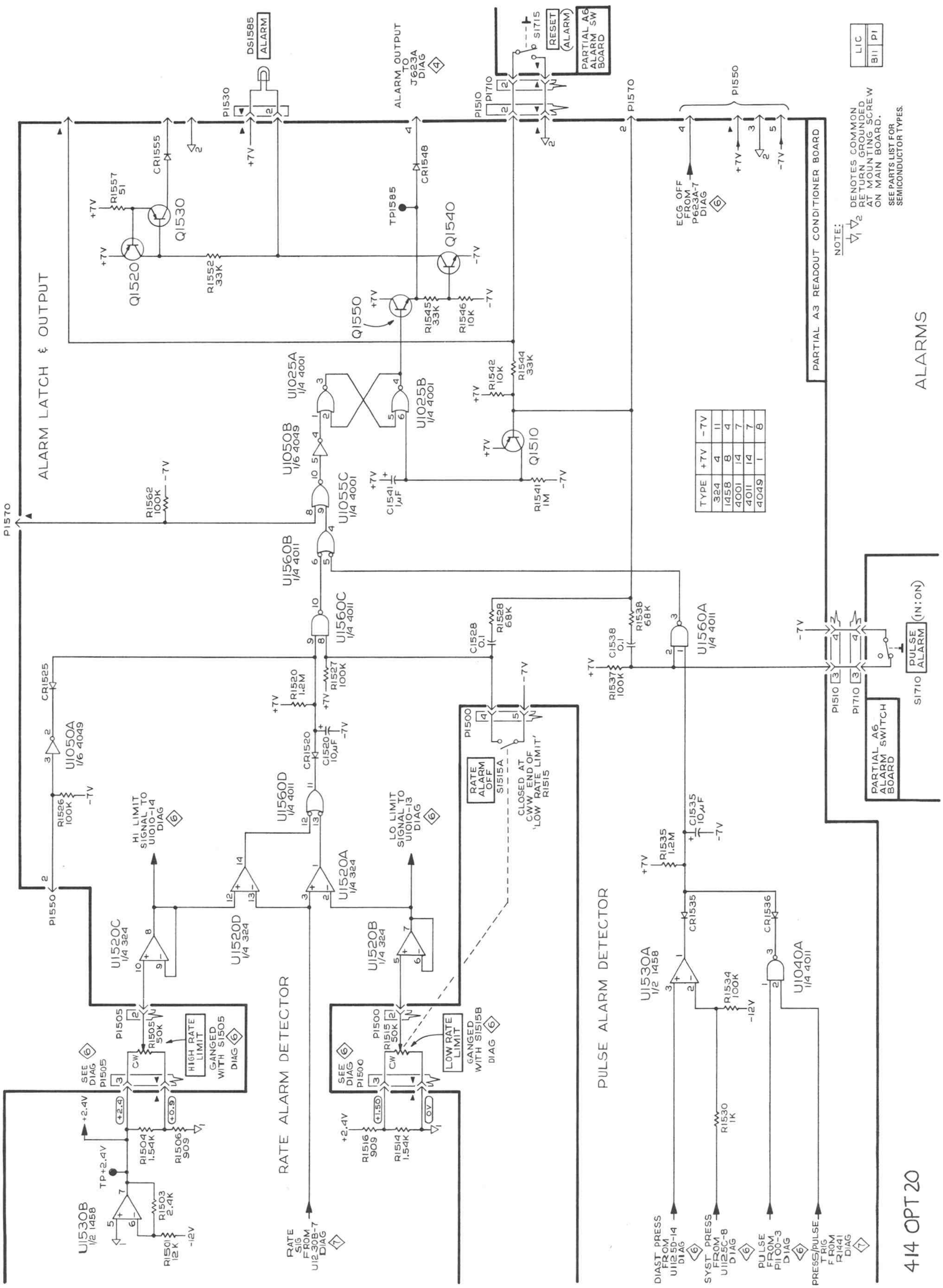
Opt. 20, Fig. 2. Vertical and horizontal amplifier diagram.



Opt. 20, Fig. 3. Switching and pressure converters diagram.



Opt. 20, Fig. 4. Temperature and rate converters diagram.



Opt. 20, Fig. 5. Alarms diagram.

REPLACEABLE ELECTRICAL PARTS

OPTION 20

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:						
A2	670-2704-02	B010100	B086774	CKT BOARD ASSY:PULSE	80009	670-2704-02
A2	670-2704-03	B086775		CKT BOARD ASSY:PULSE	80009	670-2704-03
A3	670-4359-02	B010100	B085163	CKT BOARD ASSY:READOUT CONDITIONER	80009	670-4359-02
A3	670-4359-06	B085164		CKT BOARD ASSY:READOUT CONDITIONER	80009	670-4359-06
A5	670-4362-01			CKT BOARD ASSY:READOUT SELECTOR	80009	670-4362-01
A8	670-5166-00			CKT BOARD ASSY:DISPLAY	80009	670-5166-00
R446	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R448	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1430	321-0151-00			RES.,FXD,FILM:365 OHM,1%,0.125W	91637	MFF1816G365R0F
R1432	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
R1441	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
S1850	260-1570-00	B010100	B063439	SWITCH,PUSH:2 STA,2 POLE	82104	OBD
S1850	260-1570-01	B063440	B074200	SWITCH,PUSH:2 BTN,2 POLE	80009	260-1570-01
S1850	260-1570-00	B074201	B084709	SWITCH,PUSH:2 BTN,2 POLE	82104	OBD
S1850	260-1570-01	B084710		SWITCH,PUSH:2 BTN,2 POLE	80009	260-1570-01
ADD:						
C450	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
CR449	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
R655	315-0272-00	XB085164		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R845	315-0102-00	XB085164		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1091	315-0272-00	XB085164		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1216	315-0102-00	XB084200		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1521	315-0272-00	XB085164		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1536	315-0272-00	XB085164		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
DELETE:						
C1029	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1037	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1040	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1044	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1046	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1051	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1061	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1110	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1112	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1114	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1116	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1120	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1122	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1124	290-0722-00			CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1126	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR1005	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1007	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1008	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1017	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1019	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1027	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1033	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1034	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1051	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1061	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
J603	131-1862-00			JACK,TELEPHONE:	82389	112B

REPLACEABLE ELECTRICAL PARTS

OPTION 20

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
J605	131-1862-00			JACK,TELEPHONE:	82389	112B
J1582	131-1862-00			JACK,TELEPHONE:	82389	112B
R413	311-1856-00			RES.,VAR,NONWIR:PNL,2.5M OHM,1W,4PST	01121	14M352
	----- -----			(FURNISHED AS A UNIT WITH S413)		
R603	321-0612-02			RES.,FXD,FILM:500 OHM,0.5%,0.125W	91637	MFF1816D500R0D
R604	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R605	321-0612-02			RES.,FXD,FILM:500 OHM,0.5%,0.125W	91637	MFF1816D500R0D
R607	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R1024	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1026	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R1027	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R1028	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	91637	MFF1816G63400F
R1032	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R1033	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1034	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1036	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1037	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1040	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1042	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1044	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1046	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1047	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1050	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1051	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R1060	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1061	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R1114	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1116	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1118	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1124	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1126	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1128	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1423	321-0202-09			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816C12400F
R1424	311-1859-00			RES.,VAR,NONWIR:TRMR,200 OHM,0.5W,LINEAR	32997	3299X-R27-201
R1427	321-0641-07			RES.,FXD,FILM:1.8K OHM,0.1%,0.125W	91637	MFF1816C18000B
S413	----- -----			(FURNISHED AS A UNIT WITH R413)		
S1425	260-1812-00			SWITCH,SLIDE:DPDT,0.5A,125VAC/VCD	82389	11P1076
S1850	260-1813-00	B010100	B063438	SWITCH,PUSH:DPDT,1A,28VAC 4 BUTTON	71590	OBD
S1850	260-1884-00	B063439		SWITCH,PUSH:2 POLE,2 BTN,PULSE	71590	2KCC0200001599
U1015	156-0366-00			MICROCIRCUIT,DI:DUAL D-TYPE F-F	80009	156-0366-00
U1105	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U1110	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U1115	156-0495-00			MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1120	156-0495-00			MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1125	156-0495-00			MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1130	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00
U1135	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V

REPLACEABLE MECHANICAL PARTS

OPTION 20

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
CHANGE TO:							
	331-0432-00			1	MASK READOUT:	80009	331-0432-00
	200-2109-00			1	COVER,HOLE:OUTPUT	80009	200-2109-00
	200-2110-00			1	COVER,HOLE:	80009	200-2110-00
	333-2331-00			1	PANEL,FRONT:	80009	333-2331-00
	333-2354-00			1	PANEL,FRONT:	80009	333-2354-00
	131-0608-00			4	TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0621-00			6	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	136-0566-00			1	SKT,PL-IN ELEK:READOUT TUBE	52536	CS-333
	136-0727-00			3	SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	150-1016-00			1	LAMP,GLOW,RDOUT:ORANGE,3.0 DIGIT	52536	SP333
	162-0026-00			1	INS SLV,ELEC:BULK,0.58 INCH OD	83309	OBD
	175-0076-00			1	CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
	175-0826-00			1	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	210-0223-01			1	TERMINAL,LUG:0.25 INCH DIA,SE,60 DEG BEND	86928	OBD
	211-0097-00			1	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	211-0186-00			4	SCREW,MACHINE:0-80 X 0.125,FILH,SST,SLOT	12360	00A008AHBUU01
	337-2408-00			1	SHLD,IMPLOSION:	80009	337-2408-00
	352-0199-00			2	CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	352-0239-00			2	LAMPHOLDER:(1)WIRE LEAD TYPE	80009	352-0239-00
	366-1402-98			1	PUSH BUTTON:OFF	80009	366-1402-98
	361-0384-00	B010100	B063439	4	SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0385-00	B063440	B074200	4	SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
	361-0384-00	B074201	B084709	4	SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0385-00	B084710		4	SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
DELETE:							
	366-0261-01			1	KNOB:SIL GY,0.125 ID X 0.312 OD X0.406 H	80009	366-0261-01
	366-1402-91			1	PUSH BUTTON:SIL GY,MEAN	80009	366-1402-91
	366-1402-99			1	PUSH BUTTON:SIL GY,25	80009	366-1402-99
	366-1489-25			1	PUSH BUTTON:SIL GY,250	80009	366-1489-25
	366-1557-46			1	PUSH BUTTON:SIL GY,DISPLAY OFF	80009	366-1557-46
	366-1557-47			1	PUSH BUTTON:SIL GY,SYST-DIAST	80009	366-1557-47
	366-1557-48			1	PUSH BUTTON:SIL GY,100MM CHECK	80009	366-1557-48
	366-1557-49			1	PUSH BUTTON:SIL GY,5	80009	366-1557-49

414
OPT 21

The 414 Option 21 is a three-trace portable monitor for simultaneous display of ECG and two blood pressure waveforms.

The 414 Option 21 monitor is the same as the standard 414 except that the Pulse channel is replaced by a second pressure channel.

The original pressure channel is designated A/V (Arterial/Venous) with the normal sensitivity ranges: 250, 150, and 50 mmHg. The added pressure channel is designated A (Arterial) and has a fixed sensitivity range of 250 mmHg (50 mmHg per major division of graticule display). Each pressure channel has a rear-panel connector, front-panel ZERO adjustment and DISPLAY OFF pushbutton. A "dot/dash" presentation of pressure waveforms aids channel recognition.

A front-panel pushbutton switch, marked "IN A/V OUT A", provides selection of either the A or the A/V pressure channel for digital readout of Systolic/Diastolic or Mean pressure parameters. It also selects the pressure channel monitored for pressure alarm.

Each pressure channel is equipped with a sensing circuit which responds to the presence or absence of a transducer at the input connector. When no transducer is attached, the excitation voltage to the input connector for that channel is turned off and the channel signal circuits are set for zero indication.

Crt display time-sharing is modified to provide selection of any one, any two, or all three channels.

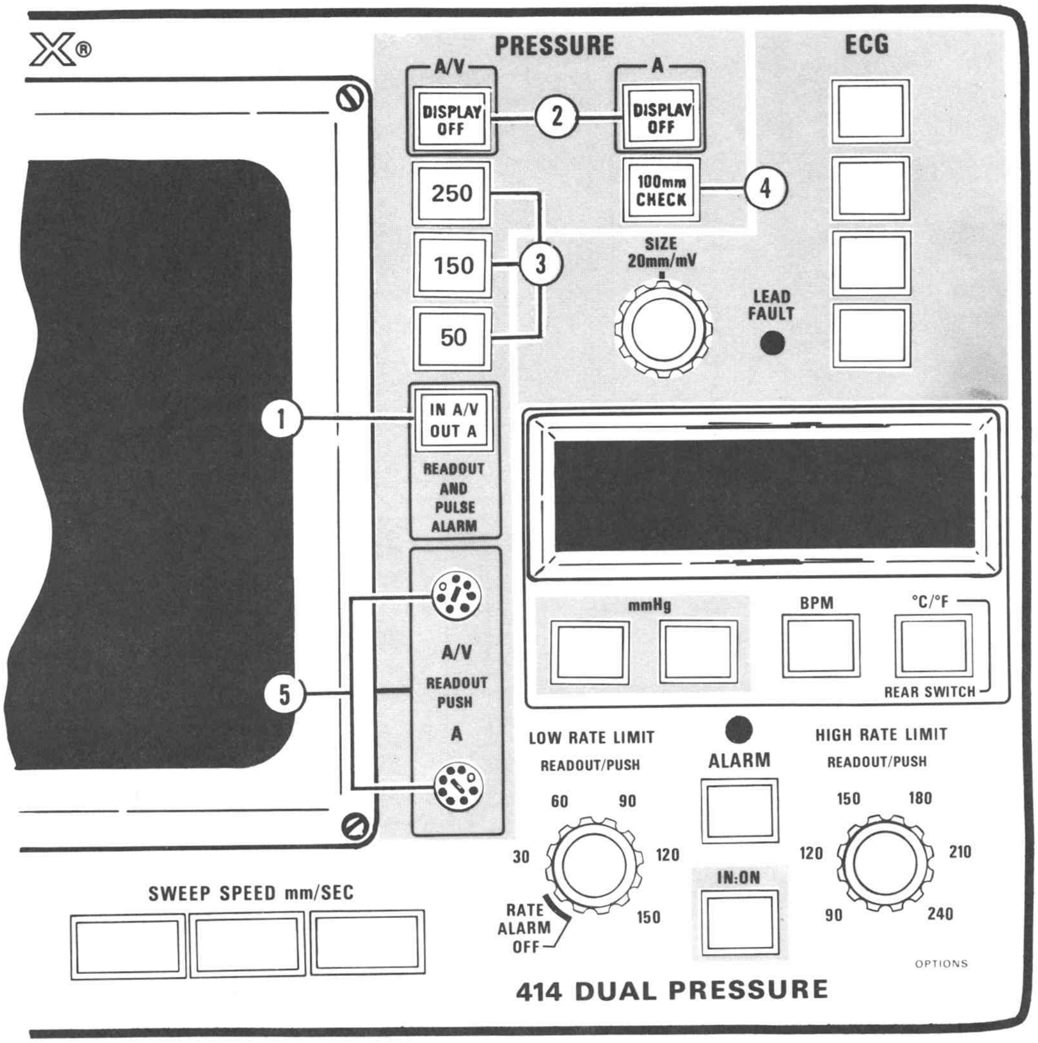
Option 21, Table 1

Electrical Specifications

Characteristic	Performance Requirement	Supplemental Information
PRESSURE		
Transducer Sensor		Pressure channels are always on when POWER switch is on and pressure transducers are connected to the PRESSURE INPUT connectors. When no transducer is connected to a channel, that channel is automatically shut off; does not remove trace from crt.
DISPLAY OFF		Analog information for either channel can be removed from the crt screen by pressing the corresponding DISPLAY OFF pushbutton.

Option 21, Table 1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Ranges		
Arterial (A) Channel	250 (−50 to +300 mmHg).	All ranges can provide up to one centimeter of display for vacuum and one centimeter of display above top of marked scale.
Arterial/Venous (A/V) Channel	250 (−50 to +300 mmHg). 150 (−30 to +180 mmHg). 50 (−10 to +60 mmHg).	
Display Accuracy	Within 5% of full scale, analog.	
Analog Output		
A Channel (RING contact)	10 mV/mmHg.	−0.5 V to +3.0 V full scale.
A/V Channel (TIP contact)	10 mV/mmHg.	250 mmHg Range, ≈−0.5 V to +3.0 V full scale. 150 mmHg Range, ≈−0.3 V to +1.8 V full scale. 50 mmHg Range, ≈−0.05 V to +0.3 V full scale.
Excitation		
A Channel	Approximately ±4 V, Pulsed.	
A/V Channel	Approximately ±8 V, Pulsed.	
Bandwidth		DC to approximately 20 Hz.
100 mm CHECK	100 mmHg. Confirms system function and sensitivity.	Within 2%.
ALARM LIMITS		
Pulse alarm	The alarm is triggered when the average pulsatile pressure (systolic minus diastolic) of the channel selected remains below 12-15 mmHg for 3-15 seconds.	The channel used for pulse alarm is determined by setting of pushbutton market OUT A, IN A/V.
DIGITAL DISPLAY		
Pressure		
Source	Determined by pushbutton marked OUT A, IN A/V.	Displays digital information independent of either DISPLAY OFF switch position.



Opt. 21, Fig. 1. Front-panel controls.

FUNCTIONS OF CONTROLS AND CONNECTORS

FRONT PANEL (Opt. 21, Fig. 1)

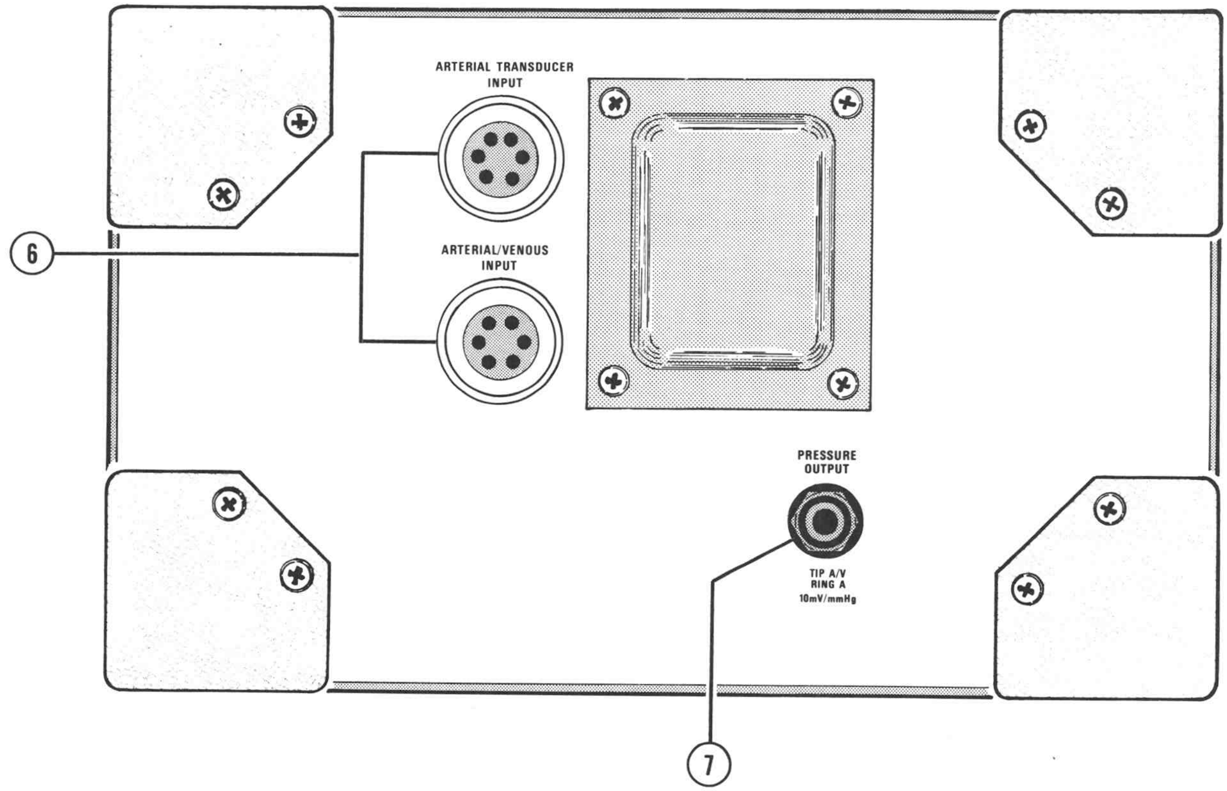
(1) **OUT A, IN A/V.** Allows either the A or A/V channel to be selected for digital readout of SYST/DIAST or MEAN pressure values. The channel selected for readout is also the channel monitored for pressure alarm.

(2) **DISPLAY OFF.** Removes the A and/or A/V pressure display(s) from the screen. When both buttons are in, the ECG display (if present) is centered on the screen. If either DISPLAY OFF pushbutton is out (display on), the ECG display baseline is about 2 cm above the screen centerline.

(3) **A/V Channel Pressure Ranges.** Three pressure ranges are selectable for the A/V pressure channel: 250 (−50 to +300 mmHg), 150 (−30 to +180 mmHg), and 25 (−5 to +30 mmHg). Pressure scales printed on the crt (cathode-ray tube) graticule, correspond to the three pressure ranges. The A channel pressure range is not selectable, but fixed at 250 (−50 to +300 mmHg).

(4) **100 mm CHECK.** Usable only with standardized pressure transducers that contain a factory standardized calibration resistor. With transducers connected to the monitor, pressing this button provides a 100 mm test signal on the pressure display. Serves both A/V and A channels simultaneously.

(5) **ZERO Adjustments.** Permits establishment of zero-pressure references. The controls are adjustable with fingertip or screwdriver. Pressing the knob in while rotating provides fast, accurate indication on the digital display. If both ZERO knobs are pressed at the same time, there will be no digital readout of either channel.



Opt. 21, Fig. 2. Rear-panel connectors.

REAR PANEL (Opt. 21, Fig. 2)

(6) **TRANSDUCER INPUT Connectors.** Provides a means for connecting Pressure Transducer signals to the Arterial (A) and/or Arterial/Venous (A/V) pressure channels. With no transducer connected, a channel is automatically shut off. When transducers are connected to both A and A/V connectors, the pressure channels are time-shared. Since both pressure displays occupy the same area on the crt screen, the traces are displayed as broken-line segments with a different pattern for each trace to aid display recognition.

(7) **PRESSURE OUTPUT.** Provides high-level (10 mV/mmHg) pressure-channel signal outputs from both channels through a stereo-type phone plug. The A/V signal appears on the TIP contact and the A signal on the RING contact. Low-level outputs are not available. **Do not use a non-stereo phone plug in this connector; doing so will cause the channel A amplifier to be disabled.**

THEORY OF OPERATION

(Replaces PRESSURE/PULSE BOARD portion of the Theory of Operation Section)

PRESSURE BOARD

CIRCUIT FUNCTIONS

The pressure circuit (Opt. 21, Fig. 7) accomplishes the following:

1. Provides excitation power to the transducers.

2. Amplifies the pressure transducer output signals. In the A/V pressure mode, three amplification ranges are provided: 25 mmHg, 150 mmHg, and 250 mmHg. In the A pressure mode, the amplification range is fixed at 250 mmHg.

3. Provides zeroing of transducer imbalance, with a front-panel ZERO control for each channel.

4. Provides a 100 mmHg calibration check activated by 100 mm CHECK pushbutton on front panel (100 mmHg display on both pressure channels). If pressure channel A/V is in 25 mmHg range, pressing 100 mm CHECK pushbutton will cause display to go off screen and readout display to flash, indicating overrange.

5. Provides amplified pressure output signal to a rear-panel jack.

6. Provides the Readout Conditioner board with an amplified pressure signal (from channel A or A/V) as selected by front-panel pushbutton marked, OUT A, IN A/V.

7. Provides an amplified pressure display signal to the Vertical Amplifier from either the A channel, the A/V channel, or both (determined by the front-panel DISPLAY OFF pushbuttons). The display zero is offset three centimeters below screen center.

8. Provides a logic signal to indicate whether the pressure channels are off or on. This signal goes to:

   a. The Main board, to allow display of the pressure channel(s) either alone or with the ECG channel.

   b. The ECG board, to set the ECG display baseline position 2 cm above screen center when one or both pressure channels are displayed.

9. Provides a logic trigger signal that switches from LO to HI during the positive-going portion of a pressure waveform. This signal is used only when ECG is off, for:

   a. Sweep Trigger.
   b. Rate Alarm.
   c. Beat Tone.
   d. Rate Digital Display.

PRESSURE CIRCUIT OPERATION

INTRODUCTION

The Pressure circuit, (Opt. 21, Fig. 7) consists of two chopper-stabilized amplifiers; one is called the Arterial (A) channel and the other Arterial/Venous (A/V). Each channel can be used independently or time-shared with the other. When no transducer is connected to one of the PRESSURE INPUT connectors, that channel is automatically disabled, its output is set to zero, and its baseline trace remains at the graticule ZERO line.

The Timing Logic circuit, controlled by trace-chop clock signal from the Main board, determines the time-sharing sequence of the channels. Since both channels occupy the same area on the crt screen, the traces are displayed as broken-line segments with a different pattern for each trace to aid display recognition. This is accomplished through the Timing Logic circuit, the Trace-Switching circuit, and electronic switches U3088C and U3088B.

Either or both displays can be removed from the crt screen by pressing the DISPLAY OFF pushbutton for that channel. When only one pressure channel is being displayed, its trace appears as a solid line.

In the following Detailed Circuit Description, circuit numbers for the A/V pressure channel are shown in parentheses.

DETAILED CIRCUIT DESCRIPTION

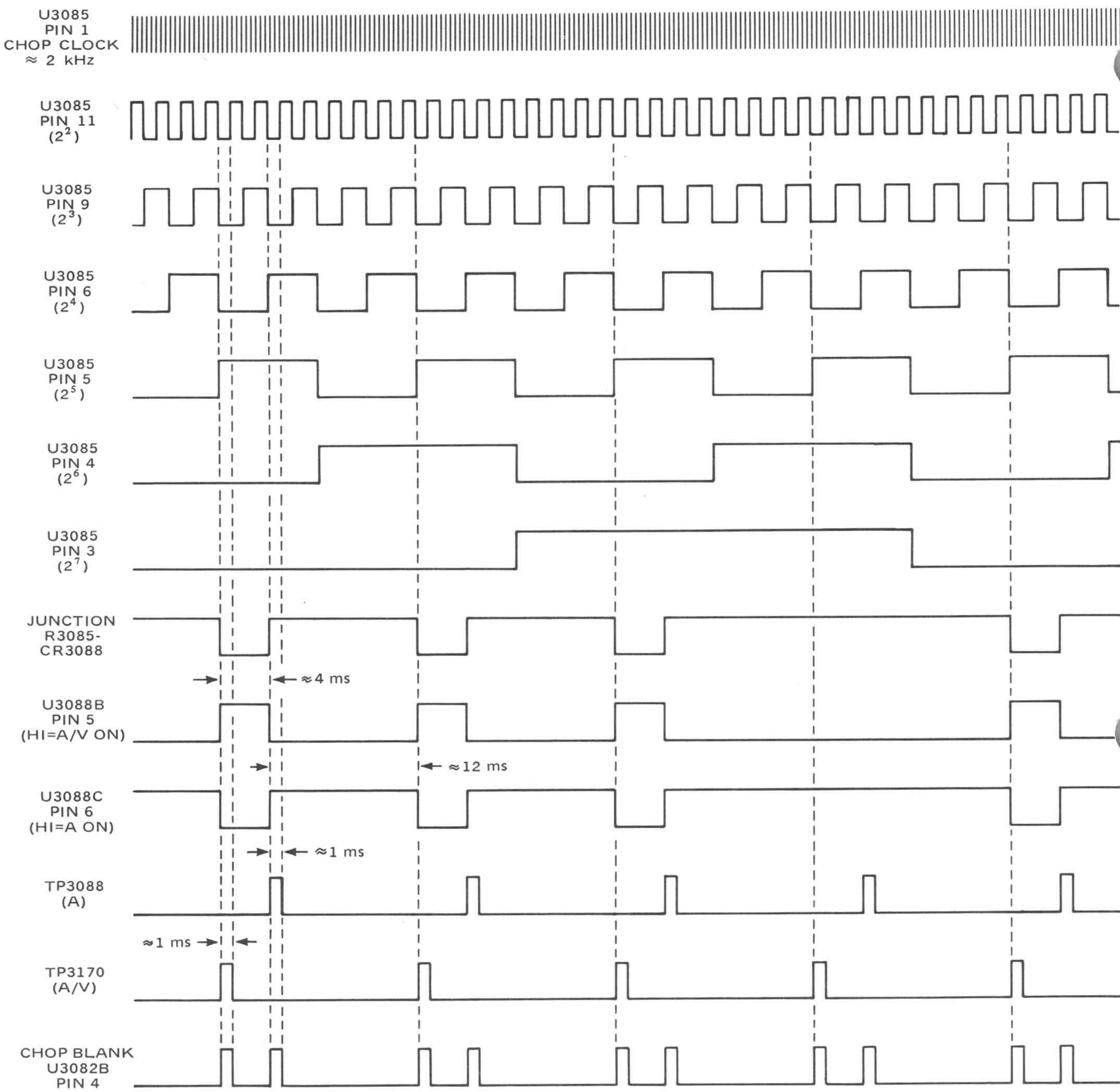
TIMING LOGIC. The Timing Logic circuit provides signals which activate chopping and time-sharing sequences in the Pressure circuit.

The Timing Logic circuit is made up of a counter (U3085) whose outputs are connected to a number of semiconductor gates and inverters. Time-related logic signals, from the Timing Logic circuit, go to the Control Logic, Chop Blank Control, and Trace Switching circuits to provide the chopping and time-sharing sequences. Counter U3085 is controlled by a 2 kHz signal from the Trace-Chop Multi on the Main board. See Opt. 21, Fig. 3 for Timing Diagram.

CONTROL LOGIC. The Control Logic circuits consist of U3046A (U3046C), U3046B (U3046D), U3068D (U3068C), U3068E (U3068B), and U3070A (U3070D).

The Control Logic circuits determine the chopping-event sequences. Opt. 21, Fig. 4 shows the time relationships between the Timing Logic output at TP3088 (TP3170) and the transmission gates (electronic switches) U3018B (U3018D) and U3018C (U3018A) and the Excitation Supply.

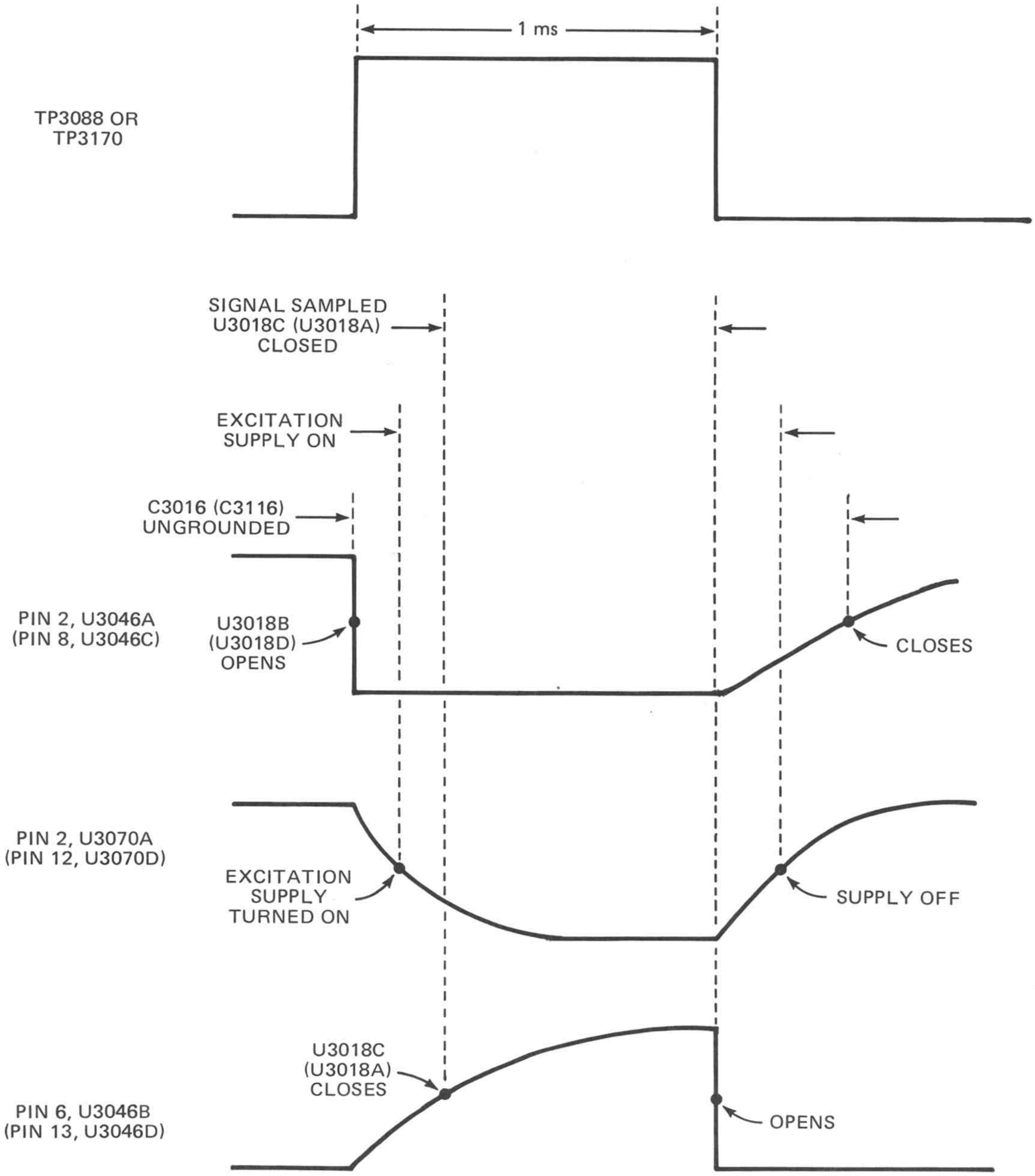
Before the timing pulse appears at TP3088 (TP3170), pin 6 of U3018C (pin 13 of U3018A) is LO (Sample & Hold switch, open) pin 3 of U3070A (pin 11 of U3070D) is LO (Excitation Supply, off) and pin 5 of U3018B (pin 12 of U3018D) is HI (DC Restorer switch, closed).



Opt. 21, Fig. 3. Pressure-circuit timing diagram.

When the rising portion of the approximately 1 ms timing pulse appears at TP3088 (TP3170), pin 5 of U3018B (pin 12 of U3018D) immediately goes LO, opening the DC Restorer switch. CR3048 (CR3148) prevents delay of opening. After a short ime delay — determined by C3071-R3071 (C3171-R3171) — pin 3 of U3070A (pin 11 of U3070D) goes LO, turning on the Excitation Supply. After a longer time delay — determined by C3077-R3078 (C3177-R3178) — pin 6 of U3018C (pin 13 of U3018A) goes HI, closing the Sample & Hold switch which allows the pressure signal to be sampled.

As the 1 ms timing pulse ends, pin 6 of U3018C (pin 13 of U3018A) immediately goes LO, causing the Sample & Hold switch to open. CR3078 (CR3178) prevents delay of opening. After a short time delay — determined by C3071-R3071 (C3171-R3171) — pin 3 of U3070A (pin 11 of U3070D) goes HI, turning off the Excitation Supply. After a longer delay — determined by C3047-R3048 (C3147-R3148) — pin 5 of U3018B (pin 12 of U3018D) goes HI, closing the DC Restorer switch.



Opt. 21, Fig. 4. Time relationships between timing-logic output at TP3088 (TP3170), the transmission gates U3018B (U3018D) and U3018C (U3018A), and the Excitation Supply.

TRACE SWITCHING CONTROL. A logic signal from the Timing Logic circuit — junction of CR-3088-R3085 — controls which amplified pressure signal goes to the Display Amplifier circuit.

When the A DISPLAY OFF pushbutton is out and the logic signal is HI, pin 6 of U3088C is HI and the A pressure channel is displayed.

When the A/V DISPLAY OFF pushbutton is out and the logic signal is LO, pin 5 of U3088B is HI and the A/V pressure channel is displayed.

DISPLAY OFF CONTROL. When both DISPLAY OFF pushbuttons are out, pin 2 of U3084A is LO which allows the Chop Blank signal to pass through U3082B to the Main board. When either DISPLAY OFF control is pushed in, the Chop Blank output at pin 4 of U3082B remains LO.

INPUT AMPLIFIERS. The Input Amplifiers are differential-to-single-ended-out amplifiers composed of U3000A, B, C, and D (U3100A, B, C, and D). The gain of channel A is calibrated to about X250.

In channel A/V, the display ranges are changed by switching gain resistors R3108 and R3109 at the input to

U3100C. The amplifier gain at each pressure range is approximately as follows: X125 at 250 mmHg, X208.3 at 150 mmHg and X1250 at 25 mmHg. The difference in the gain of channel A and the gain of Channel A/V at 250 mmHg is due to a difference in excitation voltages.

Capacitor C3005 (C3105) adds substantial dc degeneration to the amplifier to keep the quiescent dc level low at the output of U3000C (U3100C). Since the amplifier is chopper stabilized, flat response to dc is not necessary.

The 100 mm CHECK pushbutton switch S3000A shifts the display by 100 mmHg when using a properly standardized transducer with a calibration resistor.

The ZERO control, R3050 (R3150), corrects transducer residual imbalances.

The excitation voltage supplied to the pressure transducer is pulsed to provide part of the chopping signal to the amplifier. When the Excitation Supply is off, the inputs to high-gain amplifier U3000A and D (U3100A and D) are effectively shorted together through the transducer resistance, creating a no-signal condition.

When the Excitation Supply is turned on, a pulse whose amplitude is proportional to the pressure appears at the output side of interstage coupling capacitor C3016 (C3116).

Dc Restoration. During the time that the Excitation Supply is turned off — controlled by the Timing Logic circuit through U3070A (U3070D) — interstage coupling capacitor C3016 (C3116) is grounded through U3018B (U3018D). Thus, any input amplifier offset, including drift, establishes a charge on C3016 (C3116). At this time U3018C (U3018A) is open.

Shortly after the Excitation Supply turns on, the pressure pulse appears at U3000C (U3100C) output. Since the coupling capacitor was previously charged to the amplifier offset level, only the signal representing the pressure level is passed on (dc restoration).

SAMPLE & HOLD. Sample & Hold switch U3018C (U3018A) now closes, and holding capacitor C3018 (C3118) charges to the new signal level. Sample & Hold switch U3018C (U3018A) then opens, the Excitation Supply shuts off, and finally U3018B (U3018D) closes and again grounds the coupling capacitor.

All amplification in the Pressure channels precedes the interstage coupling capacitors. All subsequent stages are at unity gain. This method of amplification results in fewer operator controls. Since all dc offsets of the amplifier (including drift) are eliminated by this method, there is no need for a dc balance control. The only controls required are the ZERO controls which correct for residual imbalances in the pressure transducer and any unwanted pressure head due to elevation difference between patient and transducer.

EXCITATION SUPPLIES. Each Excitation Supply consists of a pair of inverting operational amplifiers U3055A,B (U3155A,B) and a pair of emitter followers, Q3050, Q3060 (Q3150, Q3160).

When the output of U3070A (U3070D), in the Control Logic circuits, goes HI, the output of U3068F (U3068A) goes from HI to LO. This causes the current in R3058 (R3158) to be shunted away from the supply and allows the emitter of Q3050 (Q3150) to rise to a voltage level determined by R3055 (R3155) and R3057 (R3157).

When the output of U3070A (U3070D) goes LO again, current is injected from R3058 (R3158) and R3068 (R3168) into the summing mode, pin 6 of U3055B (pin 2 of U3155A). The R3058 (R3158) and R3068 (R3168) current is slightly greater than the current from the −12 volt supply via R3057 (R3157), and the amplifier output tries to regulate to some negative voltage. When the output attempts to go negative, CR3056 (CR3156) turns on and provides feedback to pin 6 of U3055B (pin 2 of U3155A), setting Q3050 (Q3150) base at about −0.7 volt. Q3050 (Q3150) turns off and the output level at TP3050 (TP3150) is essentially zero volt.

The other halves (negative sides) of the Excitation Supplies function in exactly the same manner as the positive sides, except that they are referenced to the plus sides so that they produce a voltage equal to the plus sides, but of opposite polarity.

TRANSDUCER DETECTORS. Transducer Detectors are composed of Q3045 (Q3145) and associated circuitry.

When a transducer is connected, pin 1 of U3000A (U3100A) is sufficiently high to keep CR3040 (CR3140) forward biased and Q3045 (Q3145) turned off. This keeps pin 1 of U3046A (pin 9 of U3046 C) and pin 5 of U3046B (pin 12 of U3046D) held HI, and pin 1 of U3070A (pin 13 of U3070D) held LO. In this state, a pulse from the Timing Logic circuit can control DC Restorer switch U3018B (U3018D) Sample & Hold switch U3018C (U3018A), and turn on the Excitation Supply.

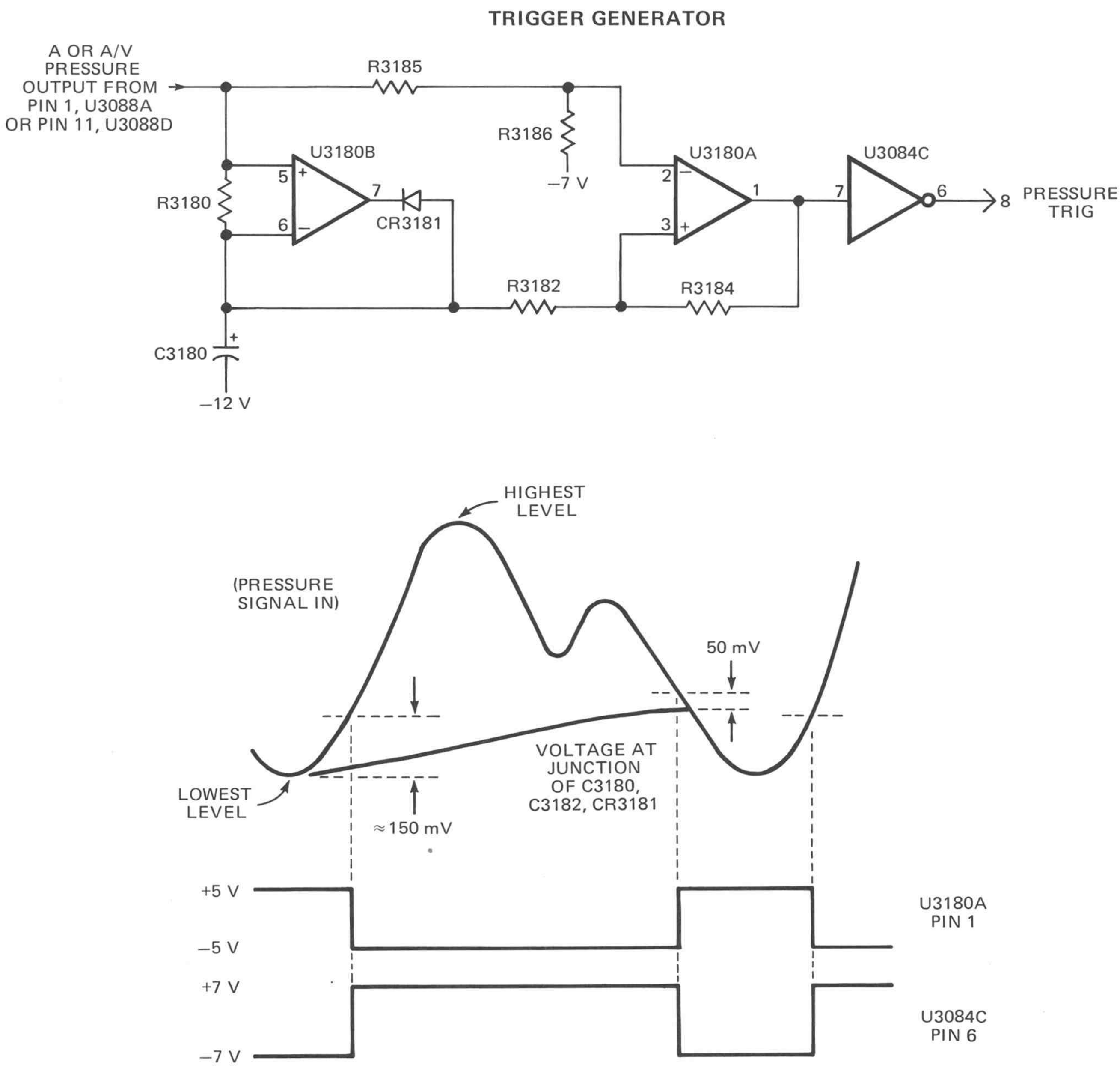
The primary purpose of this filter is to smooth the reconstruction of the pressure signal which is delivered by the Sample and Hold circuit.

TRIGGER GENERATOR. U3088A and U3088D select which pressure signal is used for triggering purposes. Whenever a transducer is connected to the ARTERIAL PRESSURE INPUT connector, pin 12 of U3088D is LO (open) and pin 13 of U3088A is HI (closed).

The Trigger Generator circuit converts the A or A/V pressure signal from U3088A or U3088D to a step signal at U3180A output. The step at U3180A output is inverted by U3084C.

The inverted step triggers the horizontal sweep, rate alarm, beat tone, and rate digital display, when the ECG channel is off.

The trigger circuit produces a positive-going step of approximately −7 to +7 volts at the inverter (U3084C) output, at about 150 mV above the most negative excursion of the pressure signal. See Opt. 21, Fig. 5.



Opt. 21, Fig. 5. Pressure trigger circuit showing time and approximate voltage levels.

When the transducer is removed, pin 3 of U3000A (U3100A) goes towards −7 V through R3032 (R3132) causing pin 1 of U3000A (U3100A) to drop, back-biasing CR3040 (CR3140) and turning on Q3045 (Q3145). With Q3045 (Q3145) turned on, U3018C (U3018A) is held open, U3018B (U3018D) is held closed, and pin 1 of U3070A (pin 13 of U3070D) is held HI, preventing the Excitation Supply from being turned on. This also holds pin 12 of U3088D HI (closed) and allows A/V signal to be used for triggering.

BUTTERWORTH FILTERS. Components R3020 (R3120), R3022 (R3122), C3022 (C3122), C3023 (C3123), C3024 (C3124), and U3025B (U3125A) make up a 2-pole, low-pass Butterworth filter.

As the input signal goes negative, pin 5 of U3180B is more negative than pin 6. Pin 7 goes negative, CR3181 conducts, and the charge on C3180 goes negative with the input on pin 5.

The input signal reaches its most negative excursion and starts positive. Since pin 6 is held at the most negative excursion of the input signal by C3180, and pin 5 starts positive, pin 7 goes positive and turns CR3181 off.

Pin 2 of U3180A is approximately 100 mV below the input signal due to current in R3185 (set by R3186 to −7 volts).

Pin 1 of U3180A is HI (approximately +5 volts). The approximately 5 microamperes of R3184 current through R3182 sets pin 3 at about 50 millivolts above the voltage on C3180.

When the input signal rises to about +150 millivolts (100 millivolts plus 50 millivolts) above its most negative excursion, U3180A switches, pin 1 goes LO, and pin 6 of U3084C goes HI. Since pin 1 of U3180A has now dropped to about −5 volts, pin 3 goes to about 50 millivolts below the voltage on C3180.

As the input signal continues to rise, C3180 charges slowly in the positive direction, as shown in Opt. 21, Fig. 5.

The input signal reaches its most positive excursion and starts back down. Nothing further occurs until the level at pin 2 of U3180A drops more negative than pin 3; i.e., when the input signal drops below a level 50 millivolts (100 millivolts minus 50 millivolts) above the voltage on C3180.

Now U3180A switches back, pin 1 of U3180A goes HI, and pin 6 of U3084C goes LO. Thus, the trigger signal is a step related to the input signal, as shown in Opt. 21, Fig. 5.

ADJUSTMENTS
E. PRESSURE

(Replaces subsection E. PRESSURE/PULSE in the CHECK/ADJUST PROCEDURE)

Equipment Required

1. Manometer
2. Pressure Transducer
3. Digital Voltmeter
4. Stereo Phone Plug (Fig. 5-1A)

E1. A GAUGE FACTOR

a. Set:

DISPLAY OFF (both channels)	in (off)
OUT A, IN A/V	Out A
PULSE ALARM	out (off)
MEAN	in

b. Connect manometer to pressure transducer and pressure transducer to ARTERIAL TRANSDUCER INPUT connector on rear panel.

c. Press in A ZERO control and adjust for digital display reading of ±0.

d. Apply 250 mmHg pressure as indicated by manometer. Make sure pressure remains at 250 mmHg and is not diminishing slowly.

e. CHECK—Digital display reads 250, within 1 mmHg.

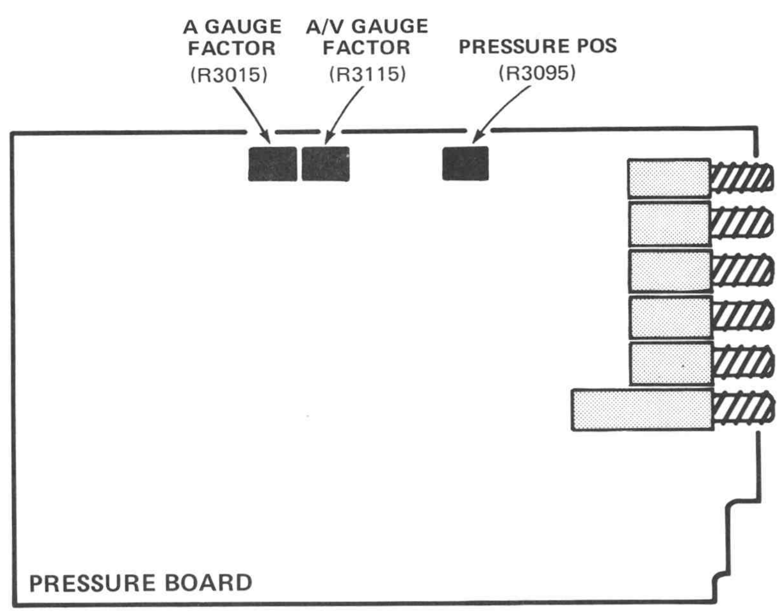
f. ADJUST—A Gauge Factor (R3025) for digital display reading of 250. (See Opt. 21, Fig. 6.)

g. Release manometer pressure.

h. CHECK—Digital display reads 0, within 1 mmHg.

i. INTERACTION—Can occur between A ZERO and A Gauge Factor adjustments. Repeat steps c through g as necessary to make difference between A ZERO and 250 mmHg digital display readings, 250, within 1 mmHg.

j. Press in A ZERO control and adjust for digital display reading of ±0.



Opt. 21, Fig. 6. Pressure-board adjustment locations.

k. Apply 100 mmHg pressure as indicated by manometer.

l. CHECK—Digital display reads 100, within 2 mmHg.

m. Set SYST/DIAST pushbutton in.

n. Apply 250 mmHg pressure as indicated by manometer.

o. CHECK—Digital display reads 250/250, within 3 mmHg.

p. Release manometer pressure.

E2. A/V GAUGE FACTOR

a. Set:

A/V PRESSURE 250	in
OUT A, IN A/V	in A/V
MEAN	in

b. Connect manometer to pressure transducer and pressure transducer to ARTERIAL/VENOUS TRANSDUCER INPUT connector on rear panel.

c. Press in A/V ZERO control and adjust for digital display reading of ±0.

d. Apply 250 mmHg pressure as indicated by manometer. Make sure pressure remains at 250 mmHg and is not diminishing slowly.

e. CHECK—Digital display reads 250, within 1 mmHg.

f. ADJUST—A/V Gauge Factor (R3115) for digital display reading of 250. (See Opt. 21, Fig. 6.)

g. Release manometer pressure.

h. CHECK—Digital display reads 0, within 1 mmHg.

i. INTERACTION—Can occur between A/V ZERO and A/V Gauge Factor adjustments. Repeat steps c through g as necessary to make difference between ZERO and 250 mmHg digital display readings, 250, within 1 mmHg.

j. Set A/V PRESSURE 150 pushbutton in.

k. Press in A/V ZERO control and adjust for digital display reading of ±0.

l. Apply 150 mmHg pressure as indicated by manometer.

m. CHECK—Digital display reads 150, within 3 mmHg.

n. Set A/V PRESSURE 50 pushbutton in.

o. Press in A/V ZERO control and adjust for digital display reading of ±0.

p. Apply 50 mmHg pressure as indicated by manometer.

q. CHECK—Digital display reads 25, within 3 mmHg.

r. Apply 100 mmHg pressure as indicated by manometer.

s. CHECK—Digital display flashes, indicating overrange condition.

t. Release manometer pressure.

E3. CHECK DUAL-PRESSURE DISPLAY

a. Set:

DISPLAY OFF (both)	out (display on)
SWEEP SPEED mm/SEC 100	in
A/V PRESSURE 250	in

b. Apply about 100 mmHg pressure as indicated by manometer connected to the A/V channel.

c. CHECK—Dual-pressure display is present on the crt screen.

d. Release manometer pressure.

E4. PRESSURE POSITION AND VERTICAL SENSITIVITY

a. Set A DISPLAY OFF pushbutton in (off).

b. Press in A/V ZERO control and adjust digital display reading of ±0. Release ZERO control.

c. CHECK—Trace should coincide with ZERO graticule line, within 1 mm.

d. ADJUST—Pressure Position (R3095) to make trace coincide with ZERO graticule line (see Opt. 21, Fig. 6.)

e. Apply 250 mmHg pressure as indicated by digital display.

f. CHECK—Trace should coincide with 250 mmHg graticule line, within 1 mm.

g. ADJUST—Vertical Sensitivity (R647, Main board) to correct one half of error.

h. INTERACTION—Occurs when adjusting Vertical Sensitivity. Repeat the Pressure Position and Vertical Sensitivity adjustments as necessary.

E5. PRESSURE OUTPUT

a. Release manometer pressure.

b. Insert stereo phone plug (Fig. 5-1C) into PRESSURE OUTPUT jack on rear panel and connect a test DVM between tip and barrel (chassis ground).

c. Set A/V PRESSURE 250 pushbutton in.

d. Press in A/V ZERO control and adjust for digital display reading of ±0. Release ZERO control.

e. CHECK—Test DVM reads 0 V, within 10 mV.

f. Apply 250 mmHg pressure to channel A/V as indicated by the 414 digital display.

g. CHECK—Test DVM reads 2.5 V, within 50 mV.

h. Move manometer and pressure transducer to ARTERIAL PRESSURE INPUT connector.

i. Connect test DVM between ring and barrel contacts of phone plug.

j. Press in A ZERO control and adjust for digital display reading of ±0. Release ZERO control.

k. CHECK—Test DVM reads 0 V, within 10 mV.

l. Set OUT A IN A/V out (A) and apply 250 mmHg pressure to channel A as indicated by the 414 digital display.

m. CHECK—Test DVM reads 2.5 V, within 50 mV.

n. Remove DVM and stereo phone plug.

E6. PRESSURE ALARM AND TRIGGER SOURCE

a. Set:

ALARM LOUDNESS (rear panel)	Midrange
OUT A, IN A/V	Out (A)

b. Connect a pressure transducer and manometer to each channel.

c. Simulate a pulsatile pressure display by applying and releasing manometer pressure to channel A about once every second. Apply sufficient pressure each time to produce a 2-3 cm display. Set PULSE ALARM in (on). Continue applying and releasing pressure for at least 30 seconds and check that alarm is not triggered. Also check that the sweep is triggered, rather than free-running.

d. Set OUT A, IN A/V pushbutton in (A/V), while continuing to apply and release pressure to channel A.

e. CHECK—Alarm is triggered within about 30 seconds. This checks that the trigger source is no longer from channel A.

f. Set PULSE ALARM pushbutton out (off).

g. Disconnect manometer and pressure transducer from channel A.

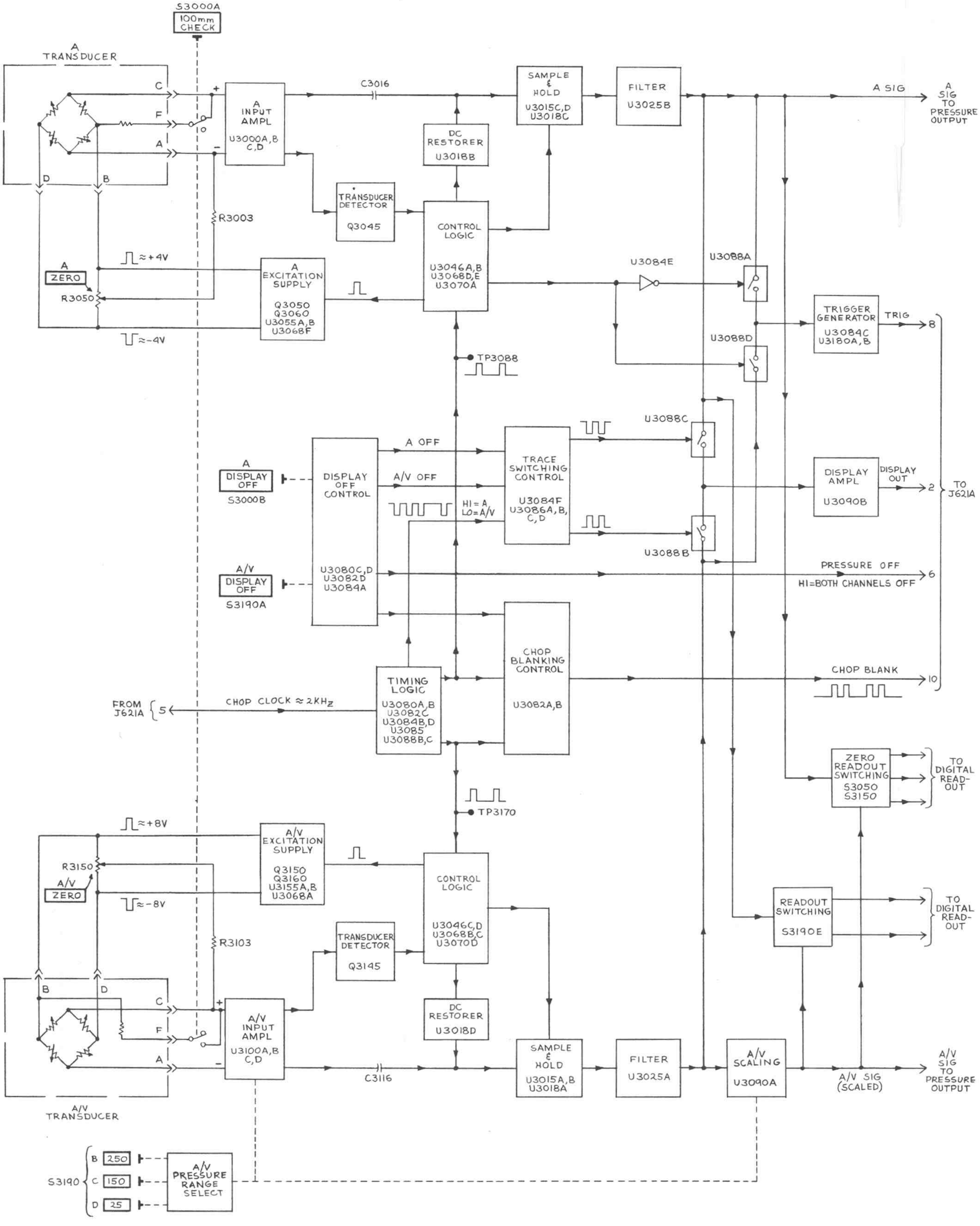
h. Simulate a pulsatile-pressure display by applying and releasing manometer pressure to channel A/V about once every second. Apply sufficient pressure each time to produce a 2-3 cm display. Set PULSE ALARM in (on). Continue applying and releasing pressure for at least 30 seconds and check that alarm is not triggered.

i. Stop applying and releasing pressure to channel A/V.

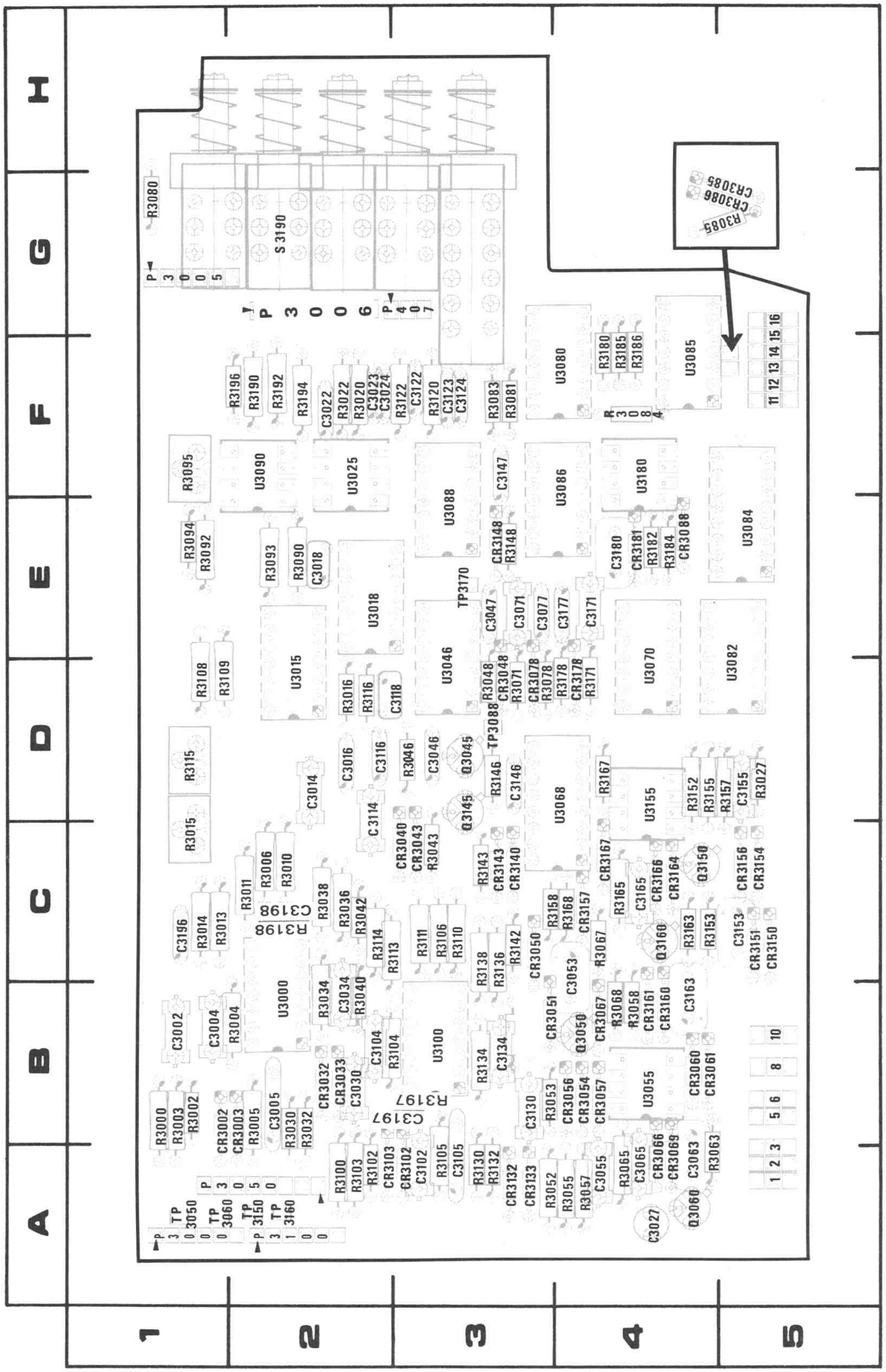
j. CHECK—Alarm is triggered within about 30 seconds.

k. Set PULSE ALARM pushbutton out (off).

l. Disconnect manometer and pressure transducer from channel A/V.



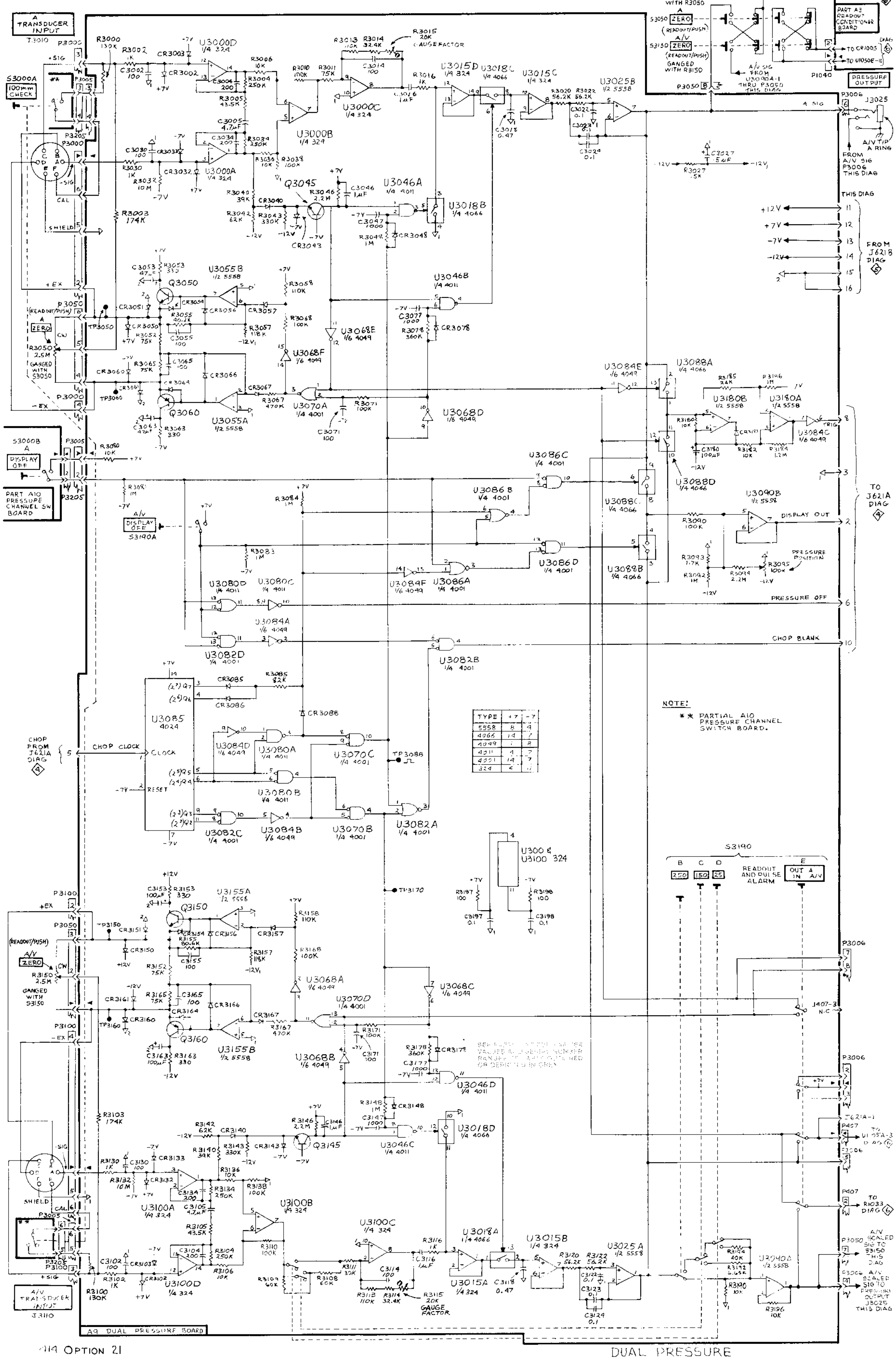
Opt. 21, Fig. 7. Block Diagram.



Opt. 21, Fig. 8. A2 Pressure board component locations.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C3002	1B	C3197	2B	CR3178	4D	R3046	3D	R3134	3B	U3025	2F
C3004	1B	C3198	2C	CR3181	4E	R3048	3D	R3136	3C	U3046	3D
C3005	2B	CR3002	1B			R3052	3A	R3138	3C	U3055	4B
C3014	2D	CR3003	2B	P407	3G	R3053	3B	R3142	3C	U3068	4D
C3016	2D	CR3032	2B	P3000	1A	R3055	4A	R3143	3C	U3070	4D
C3018	2E	CR3033	2B	P3005	1G	R3057	4A	R3146	3D	U3080	4F
C3022	2F	CR3040	3C	P3050	2A	R3048	4B	R3148	3E	U3082	5D
C3023	2F	CR3043	3C	P3006	2G	R3063	4A	R3152	4D	U3084	5E
C3024	2F	CR3048	3D	P3100	2A	R3065	4A	R3153	4C	U3085	4F
C3027	4A	CR3050	3C			R3067	4C	R3155	4D	U3086	4F
C3030	2B	CR3051	3B	Q3045	3D	R3068	4B	R3157	5D	U3088	3E
C3034	2B	CR3054	4B	Q3050	4B	R3071	3D	R3158	3C	U3090	2F
C3046	3D	CR3056	4B	Q3060	4A	R3078	3D	R3163	4C	U3100	3B
C3047	3E	CR3057	4B	Q3145	3D	R3080	1G	R3165	4C	U3155	4D
C3053	4C	CR3060	4B	Q3150	4C	R3081	3F	R3167	4D	U3180	4F
C3055	4A	CR3061	4B	Q3160	4C	R3083	3F	R3168	4C		
C3063	4A	CR3066	4A			R3084	4F	R3171	4D		
C3065	4A	CR3067	4B	R3000	1B	R3085	5G	R3178	4D		
C3071	3E	CR3069	4A	R3002	1B	R3090	2E	R3180	4F		
C3077	3E	CR3078	3D	R3003	1B	R3092	1E	R3182	4E		
C3102	3A	CR3085	5G	R3004	2B	R3093	2E	R3184	4E		
C3104	2B	CR3086	5G	R3005	2B	R3094	1E	R3185	4F		
C3105	3A	CR3088	4E	R3006	2C	R3095	1F	R3186	4F		
C3114	2D	CR3102	3A	R3010	2C	R3100	2A	R3190	2F		
C3116	2D	CR3103	2A	R3011	2C	R3102	2A	R3192	2F		
C3118	3D	CR3132	3A	R3013	1C	R3103	2A	R3194	2F		
C3122	3F	CR3133	3A	R3014	1C	R3104	3B	R3196	2F		
C3123	3F	CR3140	3C	R3015	1C	R3105	3A	R3197	3B		
C3124	3F	CR3143	3C	R3016	2D	R3106	3C	R3198	2C		
C3130	3B	CR3148	3E	R3020	2F	R3108	1D	S3190	2G		
C3134	3B	CR3150	5C	R3022	2F	R3109	1D				
C3146	3D	CR3151	5C	R3027	5D	R3110	3C	TP3050	1A		
C3147	3F	CR3154	5C	R3030	2B	R3111	3C	TP3060	1A		
C3153	5C	CR3156	5C	R3032	2B	R3113	3C	TP3088	3D		
C3155	5D	CR3157	4C	R3034	2B	R3114	2C	TP3150	2A		
C3163	4B	CR3160	4B	R3036	2C	R3115	1D	TP3160	2A		
C3165	4C	CR3161	4B	R3038	2C	R3116	2D	TP3170	3E		
C3171	4E	CR3164	4C	R3040	2B	R3120	3F				
C3177	4E	CR3166	4C	R3042	2C	R3122	3F	U3000	2B		
C3180	4E	CR3167	4C	R3043	3C	R3130	3A	U3015	2D		
C3196	1C					R3132	3A	U3018	2E		

Opt. 21, Fig. 8 (cont). Component locations grid for pressure board.



Opt. 21, Fig. 9. Dual pressure diagram.

REPLACEABLE ELECTRICAL PARTS
OPTION 21

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
DELETE:						
A2	670-4358-00			CKT BOARD ASSY:PRESSURE PULSE	80009	670-4358-00
	----- -----			(INCLUDES THE FOLLOWING CKT NUMBERS:		
	----- -----			C414 THRU C491, CR401 THRU CR498,		
	----- -----			Q450 THRU Q492, R400 THRU R499,S405,		
	----- -----			U424 THRU U476, VR452 THRU VR491)		
ADD:						
A2	670-4878-00	B010100	B073519	CKT BOARD ASSY:DUAL-PRESSURE	80009	670-4878-00
A2	670-4878-01	B073520	B086774	CKT BOARD ASSY:DUAL-PRESSURE	80009	670-4878-01
A2	670-4878-02	B086775		CKT BOARD ASSY:DUAL-PRESSURE	80009	670-4878-02
DELETE:						
A3	670-4359-00			CKT BOARD ASSY:READOUT CONDITIONER	80009	670-4359-00
ADD:						
A3	670-4359-01	B010100	B085200	CKT BOARD ASSY:READOUT CONDITIONER	80009	670-4359-01
A3	670-4359-03	B085201	B086774	CKT BOARD ASSY:READOUT CONDITIONER	80009	670-4359-03
A3	670-4359-05	B086775	B109999	CKT BOARD ASSY:READOUT CONDITIONER	80009	670-4359-05
A3	670-6415-00	B110000		CKT BOARD ASSY:READOUT CONDITIONER	80009	670-6415-00
A10	670-4877-00			CKT BOARD ASSY:PRESSURE CHANNEL SWITCH	80009	670-4877-00
ADD:						
C3002	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3004	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C3005	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N057Z5U0475M
C3014	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3016	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
C3018	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075E474M
C3022	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3023	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3024	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3027	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C3030	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3034	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C3046	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
C3047	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C3053	290-0719-00			CAP.,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
C3055	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3063	290-0719-00			CAP.,FXD,ELCTLT:47UF,20%,25V	56289	196D476X0025TE3
C3065	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3071	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3077	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C3102	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3104	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C3105	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N057Z5U0475M
C3114	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3116	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
C3118	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075E474M
C3122	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3123	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3124	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3130	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3134	281-0605-00			CAP.,FXD,CER DI:200PF,10%,500V	04222	7001-1375
C3146	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N031Z5U0105Z
C3147	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K

REPLACEABLE ELECTRICAL PARTS

OPTION 21

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C3153	290-0721-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C3155	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3163	290-0721-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C3165	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3171	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C3177	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C3180	290-0721-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C3197	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3198	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
CR3002	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3003	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3032	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3033	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3040	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3043	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3048	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3050	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3051	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3054	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3056	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3057	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3060	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3061	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3064	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3066	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3067	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3078	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3085	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3086	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3088	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3102	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3103	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3132	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3133	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3140	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3143	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3148	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3150	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3151	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3154	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3156	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3157	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3160	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3161	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3164	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3166	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3167	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3178	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR3181	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
J3010	131-1375-00			CONN,RCPT,ELEC:FLANGE MT,6 CONT,FEMALE	02660	MS3102A
J3110	131-1375-00			CONN,RCPT,ELEC:FLANGE MT,6 CONT,FEMALE	02660	MS3102A
Q3045	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q3050	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q3060	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q3145	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q3150	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487

REPLACEABLE ELECTRICAL PARTS

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q3160	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
R3000	321-0396-07			RES.,FXD,FILM:130K OHM,0.1%,0.125W	91637	MFF1816C13002B
R3002	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3003	321-0408-00			RES.,FXD,FILM:174K OHM,1%,0.125W	91637	MFF1816G17402F
R3004	321-0618-04			RES.,FXD,FILM:250K OHM,0.1%,0.125W	07716	OBD
R3005	321-1710-07			RES.,FXD,FILM:43.5K OHM,0.1%,0.125W	91637	MFF1816C43501B
R3006	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R3010	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
R3011	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R3013	321-0389-00			RES.,FXD,FILM:110K OHM,1%,0.125W	91637	MFF1816G11002F
R3014	321-0338-00			RES.,FXD,FILM:32.4K OHM,1%,0.125W	91637	MFF1816G32401F
R3015	311-1198-00			RES.,VAR,NONWIR:20K OHM,20%,0.5W	73138	72-29-0
R3016	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3020	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R3022	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R3027	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R3030	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3032	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R3034	321-0618-04			RES.,FXD,FILM:250K OHM,0.1%,0.125W	07716	OBD
R3036	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R3038	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
R3040	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R3042	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R3043	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R3046	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R3048	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3050	311-1856-00			RES.,VAR,NONWIR:PNL,2.5M OHM,1W,4PST	01121	14M352
-----	-----			(FURNISHED AS A UNIT WITH S3050)		
R3052	321-0373-04			RES.,FXD,FILM:75K OHM,0.1%,0.125W	91637	MFF1816D75001B
R3053	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3055	321-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.125W	91637	MFF1816G40201F
R3057	321-0392-00			RES.,FXD,FILM:118K OHM,1%,0.125W	91637	MFF1816G11802F
R3058	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R3063	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3065	321-0373-04			RES.,FXD,FILM:75K OHM,0.1%,0.125W	91637	MFF1816D75001B
R3067	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R3068	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3071	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3078	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R3080	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3081	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3083	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3084	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3085	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R3090	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R3092	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	24546	NA4D1004F
R3093	321-1391-01			RES.,FDD,FILM:117K OHM,0.5%,0.125W	91637	MFF1816G11702D
R3094	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R3095	311-1241-00			RES.,VAR,NONWIR:100K OHM,10%,0.5W	32997	3386X-T07-104
R3100	321-0396-07			RES.,FXD,FILM:130K OHM,0.1%,0.125W	91637	MFF1816C13002B
R3102	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3103	321-0408-00			RES.,FXD,FILM:174K OHM,1%,0.125W	91637	MFF1816G17402F
R3104	321-0618-04			RES.,FXD,FILM:250K OHM,0.1%,0.125W	07716	OBD
R3105	321-1710-07			RES.,FXD,FILM:43.5K OHM,0.1%,0.125W	91637	MFF1816C43501B
R3106	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R3108	321-0373-03	B010100	B073519	RES.,FXD,FILM:75K OHM,0.25%,0.125W	91637	MFF1816D75001C

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R3108	321-0720-07	B073520		RES.,FXD,FILM:60K OHM,0.1%,0.125W	91637	MFF1816C60001B
R3109	321-0720-03			RES.,FXD,FILM:60K OHM,0.25%,0.125W	91637	MFF1816D60001C
R3110	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
R3111	321-0373-03	B010100	B073519	RES.,FXD,FILM:75K OHM,0.25%,0.125W	91637	MFF1816D75001C
R3111	321-0685-07	B073520		RES.,FXD,FILM:30K OHM,0.1%,0.125W	91637	MFF1816C30001B
R3113	321-0389-00			RES.,FXD,FILM:110K OHM,1%,0.125W	91637	MFF1816G11002F
R3114	321-0338-00			RES.,FXD,FILM:32.4K OHM,1%,0.125W	91637	MFF1816G32401F
R3115	311-1198-00			RES.,VAR,NONWIR:20K OHM,20%,0.5W	73138	72-29-0
R3116	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3120	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R3122	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R3130	311-0102-00			RES.,VAR,WW:660 OHM	80009	311-0102-00
R3132	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R3134	321-0618-04			RES.,FXD,FILM:250K OHM,0.1%,0.125W	07716	OBD
R3136	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R3138	321-0385-07			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
R3140	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R3142	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R3143	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R3146	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R3148	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3150	311-1856-00			RES.,VAR,NONWIR:PNL,2.5M OHM,1W,4PST	01121	14M352
	----- -----			(FURNISHED AS A UNIT WITH S3150)		
R3152	321-0373-04			RES.,FXD,FILM:75K OHM,0.1%,0.125W	91637	MFF1816D75001B
R3153	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3155	321-0376-00			RES.,FXD,FILM:80.6K OHM,1%,0.125W	91637	MFF1816G80601F
R3157	321-0392-00			RES.,FXD,FILM:118K OHM,1%,0.125W	91637	MFF1816G11802F
R3158	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R3163	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R3165	321-0373-04			RES.,FXD,FILM:75K OHM,0.1%,0.125W	91637	MFF1816D75001B
R3167	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R3168	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3171	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3178	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R3180	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3182	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3184	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R3185	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R3186	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3190	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R3192	321-0272-07			RES.,FXD,FILM:6.65K OHM,0.1%,0.125W	91637	MFF1816C66500B
R3194	321-0993-07	B010100	B073519	RES.,FXD,FILM:90K OHM,0.1%,0.125W	91637	MFF1816C90001B
R3194	321-0924-07	B073520		RES.,FXD,FILM:40K OHM,0.1%,0.125W	91637	MFF1816C40001B
R3196	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3197	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R3198	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
S3000A,B	260-1859-00	B010100	B063439	SWITCH,PUSH:2 POLE 2 BTN,OFF/CHECK	82104	2939PB402-1002
S3000A,B	260-1859-01	B063440	B074200	SWITCH,PUSH:2 BTN,2 POLE,OFF/CHECK	80009	260-1859-01
S3000A,B	260-1859-00	B074201	B084709	SWITCH,PUSH:2 POLE 2 BTN,OFF/CHECK	82104	2939PB402-1002
S3000A,B	260-1859-01	B084710		SWITCH,PUSH:2 BTN,2 POLE,OFF/CHECK	80009	260-1859-01
S3050	----- -----			(FURNISHED AS A UNIT WITH R3050)		
S3150	----- -----			(FURNISHED AS A UNIT WITH R3150)		
S3190	260-1860-00	B010100	B063439	SWITCH,PUSH:4 POLE,5 BTN,PRESSURE	82104	2940PB400-1005
S3190	260-1860-01	B063440	B074200	SWITCH,PUSH:5 BTN,2 & 4 POLE,PRESSURE	80009	260-1860-01
S3190	260-1860-00	B074201	B084709	SWITCH,PUSH:4 POLE,5 BTN,PRESSURE	82104	2940PB400-1005
S3190	260-1860-01	B084710		SWITCH,PUSH:5 BTN,2 & 4 POLE,PRESSURE	80009	260-1860-01

REPLACEABLE ELECTRICAL PARTS

OPTION 21

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U3000	156-0495-00	B010100	B086334	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U3000	156-0495-02	B086335		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U3015	156-0495-00	B010100	B086334	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U3015	156-0495-02	B086335		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U3018	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00
U3025	156-0158-00	B010100	B086334	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U3025	156-0158-03	B086335		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U3046	156-0350-00	B010100	B086334	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U3046	156-0350-02	B086335		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
U3055	156-0158-00	B010100	B086334	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U3055	156-0158-03	B086335		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U3068	156-0494-00	B010100	B086334	MICROCIRCUIT,DI:HEX INVERTER/BUFFER	80009	156-0494-00
U3068	156-0494-02	B086335		MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
U3070	156-0349-00	B010100	B086334	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U3070	156-0349-03	B086335		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U3080	156-0350-00	B010100	B086334	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U3080	156-0350-02	B086335		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
U3082	156-0349-00	B010100	B086334	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U3082	156-0349-03	B086335		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U3084	156-0494-00	B010100	B086334	MICROCIRCUIT,DI:HEX INVERTER/BUFFER	80009	156-0494-00
U3084	156-0494-02	B086335		MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
U3085	156-0523-00			MICROCIRCUIT,DI:7-STAGE BINARY COUNTER	80009	156-0523-00
U3086	156-0349-00	B010100	B086334	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U3086	156-0349-03	B086335		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U3088	156-0644-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00
U3090	156-0158-00	B010100	B086334	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U3090	156-0158-03	B086335		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U3100	156-0495-00	B010100	B086334	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U3100	156-0495-02	B086335		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U3155	156-0158-00	B010100	B086334	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U3155	156-0158-03	B086335		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U3180	156-0158-00	B010100	B086334	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U3180	156-0158-03	B086335		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
REMOVE:						
J401	131-1375-00			CONN,RCPT,ELEC:FLANGE MT,6 CONT,FEMALE	02660	MS3102A
J412	131-1376-00			CONNECTOR,RCPT,:4 CONTACT	81312	M43-LRN
R413	311-1856-00			RES.,VAR,NONWIR:PNL,2.5M OHM,1W,4PST	01121	14M352
	----- -----			(FURNISHED AS A UNIT WITH S413)		
R417	311-1521-00			RES.,VAR,NONWIR:100K OHM,20%,1W	01121	73A1G032L104M
R605	321-0612-02			RES.,FXD,FILM:500 OHM,0.5%,0.125W	91637	MFF1816D500R0D
R607	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
S413	----- -----			(FURNISHED AS A UNIT WITH R413)		

REPLACEABLE MECHANICAL PARTS

OPTION 21

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
ADD:							
	366-1489-00			1	PUSH BUTTON:SIL GY,50	80009	366-1489-00
	337-2475-00			1	SHLD,IMPLOSION:	80009	337-2475-00
	260-1859-00			1	SWITCH,PUSH:2 POLE 2 BTN,OFF/CHECK	82104	2939PB402-1002
	260-1860-00			1	SWITCH,PUSH:4 POLE,5 BTN,PRESSURE	82104	2940PB400-1005
	386-3703-01			1	SUBPANEL,FRONT:	80009	386-3703-01
	333-2289-01			1	PANEL,FRONT:	80009	333-2289-01
	333-2355-00			1	PANEL,FRONT:	80009	333-2355-00
	386-3704-00			1	PLATE,CONN MTG:	80009	386-3704-00
	333-2290-00	B010100	B084679	1	PANEL,REAR:	80009	333-2290-00
	333-2290-01	B084680		1	PANEL,REAR:	80009	333-2290-01
	366-1557-78			1	PUSH BUTTON:BLACK,AUTO	80009	366-1557-78
	131-0589-00	B010100	B086973	50	TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	131-0589-00	B086974		14	TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	131-0608-00	XB086974		36	TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-1375-00			1	CONN,RCPT,ELEC:FLANGE MT,6 CONT,FEMALE	02660	MS3102A
	131-1261-00			13	CONTACT,ELEC:F-SHAPED	00779	1-380953-0
	198-3464-00	B010100	B089999	1	WIRE SET,ELEC:	80009	198-3464-00
	198-3464-01	B090000	B109999	1	WIRE SET,ELEC:	80009	198-3464-01
	198-3464-02	B110000		1	WIRE SET,ELEC:	0009	198-3464-02
REMOVE:							
	131-1376-00			1	CONNECTOR,RCPT,:4 CONTACT	81312	M43-LRN
ADD:							
	136-0252-07			18	SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0260-02			2	SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	136-0269-02			11	SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	136-0514-00			5	SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	210-0406-00			1	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
REMOVE:							
	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
ADD:							
	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
REMOVE:							
	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
ADD:							
	210-0994-00			1	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
REMOVE:							
	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
ADD:							
	211-0014-00			2	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
	211-0541-00			2	SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
	211-0186-00			4	SCREW,MACHINE:0-80 X 0.125,FILH,SST,SLOT	12360	00A008AHBUU01
REMOVE:							
	333-2141-00			1	PANEL,REAR:	80009	333-2141-00
	333-2142-00			1	PANEL,FRONT:	80009	333-2142-00
ADD:							
	343-0144-00			1	CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
REMOVE:							
	343-0617-00			1	RETAINER,CONN:PLUG GUIDE,ABS SIL GRAY	80009	343-0617-00
ADD:							
	352-0239-00			2	LAMPHOLDER:(1)WIRE LEAD TYPE	80009	352-0239-00
	361-0384-00	B010100	B063439	11	SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0385-00	B063440	B074200	11	SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
	361-0384-00	B074201	B084709	11	SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0385-00	B084710		11	SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
	366-0261-01			1	KNOB:SIL GY,0.125 ID X 0.312 OD X0.406 H	80009	366-0261-01
REMOVE:							
	366-1402-89			1	PUSH BUTTON:SIL GY,PULSE	80009	366-1402-89
	366-1495-00			1	KNOB:GRAY	80009	366-1495-00
ADD:							
	366-1557-46			1	PUSH BUTTON:SIL GY,DISPLAY OFF	80009	366-1557-46
REMOVE:							
	384-1099-00			6	EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
ADD:							
	384-1136-00			5	EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
	386-1895-00			1	SUPPORT,CKT BD:CHASSIS MT,PLASTIC	000CP	CBS-4N 1/4
REMOVE:							
	386-3513-00			1	SUBPANEL,FRONT:	80009	386-3513-00
	386-3514-00			1	PLATE,CONN MTG:REAR PANEL	80009	386-3514-00
ADD:							
	426-0681-00			2	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR
ASSY	ASSEMBLY
CAP	CAPACITOR
CER	CERAMIC
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
ELCTLT	ELECTROLYTIC
ELEC	ELECTRICAL
INCAND	INCANDESCENT
LED	LIGHT EMITTING DIODE
NONWIR	NON WIREWOUND
PLSTC	PLASTIC
QTZ	QUARTZ
RECP	RECEPTACLE
RES	RESISTOR
RF	RADIO FREQUENCY
SEL	SELECTED
SEMICOND	SEMICONDUCTOR
SENS	SENSITIVE
VAR	VARIABLE
WW	WIREWOUND
XFMR	TRANSFORMER
XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
S0482	SONY CORPORATION		TOKYO, JAPAN
0000L	MATSUSHITA ELECTRIC	200 PARK AVENUE, 54TH FLOOR	NEW YORK, NY 10017
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01002	GENERAL ELECTRIC COMPANY, INDUSTRIAL AND POWER CAPACITOR PRODUCTS DEPARTMENT	JOHN STREET	HUDSON FALLS, NY 12839
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07716	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, BURLINGTON DIV.	2850 MT. PLEASANT	BURLINGTON, IA 52601
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
16546	GLOBE UNION INC. USCC/CENTRALAB ELECTRONICS DIV.	4561 COLORADO	LOS ANGELES, CA 90039
18178	VACTEC, INC.	2423 NORTHLINE INDUSTRIAL BLVD.	MARYLAND HEIGHTS, MO 63043
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
52536	BECKMAN INSTRUMENTS, INC., INFORMATION DISPLAYS OPERATION	350 N. HAYDEN ROAD	SCOTTSDALE, AZ 85257
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77342	AMF INC., POTTER AND BRUMFIELD DIV.	200 RICHLAND CREEK DRIVE	PRINCETON, IN 47670
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81312	WINCHESTER ELECTRONICS DIVISION LITTON INDUSTRIES, INC.	MAIN ST. AND HILLSIDE AVE.	OAKVILLE, CT 06779
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
82104	STANDARD GRIGSBY CO., DIV. OF SUN CHEMICAL CORPORATION	920 RATHBONE AVENUE	AURORA, IL 60507
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
94696	MAGNECRAFT ELECTRIC COMPANY	5575 N LYNCH AVENUE	CHICAGO, IL 60630

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2702-04	B010100	B086156	CKT BOARD ASSY:ECG (STANDARD ONLY)	80009	670-2702-04
A1	670-2702-06	B086157		CKT BOARD ASSY:ECG (STANDARD ONLY)	80009	670-2702-05
A1	670-2702-04	B010100	B086799	CKT BOARD ASSY:ECG (OPTION 2 ONLY)	80009	670-2702-04
A1	670-2702-06	B086800		CKT BOARD ASSY:ECG (OPTION 2 ONLY)	80009	670-2702-05
A1	670-2702-04	B010100	B086141	CKT BOARD ASSY:ECG (OPTION 21 ONLY)	80009	670-2702-04
A1	670-2702-06	B086142		CKT BOARD ASSY:ECG (OPTION 21 ONLY)	80009	670-2702-05
A2	670-4358-00	B010100	B086779	CKT BOARD ASSY:PRESSURE/PULSE (STANDARD ONLY)	80009	670-4358-00
A2	670-4358-02	B086780		CKT BOARD ASSY:PRESSURE/PULSE (STANDARD ONLY)	80009	670-4358-02
A2	670-4358-00	B010100	B086799	CKT BOARD ASSY:PRESSURE/PULSE (OPTION 2 ONLY)	80009	670-4358-00
A2	670-4358-02	B086800		CKT BOARD ASSY:PRESSURE/PULSE (OPTION 2 ONLY)	80009	670-4358-02
A2	670-4358-00	B010100	B086803	CKT BOARD ASSY:PRESSURE/PULSE (OPTION 4 ONLY)	80009	670-4358-00
A2	670-4358-02	B086804		CKT BOARD ASSY:PRESSURE/PULSE (OPTION 4 ONLY)	80009	670-4358-02
A3	670-4359-00	B010100	B039999	CKT BOARD ASSY:READOUT CONDITIONER (STANDARD ONLY)	80009	670-4359-00
A3	670-4359-01	B040000	B085200	CKT BOARD ASSY:READOUT CONDITIONER (STANDARD ONLY)	80009	670-4359-01
A3	670-4359-03	B085201	B086779	CKT BOARD ASSY:READOUT CONDITIONER (STANDARD ONLY)	80009	670-4359-03
A3	670-4359-05	B086780	B109999	CKT BOARD ASSY:READOUT CONDITIONER (STANDARD ONLY)	80009	670-4359-05
A3	670-6415-00	B110000		CKT BOARD ASSY:READOUT CONDITIONER (STANDARD ONLY)	80009	670-6415-00
A3	670-4359-00	B010100	B039999	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 2 ONLY)	80009	670-4359-00
A3	670-4359-01	B040000	B085200	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 2 ONLY)	80009	670-4359-01
A3	670-4359-03	B085201	B086799	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 2 ONLY)	80009	670-4359-03
A3	670-4359-05	B086800	B109999	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 2 ONLY)	80009	670-4359-05
A3	670-6415-00	B110000		CKT BOARD ASSY:READOUT CONDIITONER (OPTION 2 ONLY)	80009	670-6415-00
A3	670-4359-00	B010100	B039999	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 4 ONLY)	80009	670-4359-00
A3	670-4359-01	B040000	B085200	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 4 ONLY)	80009	670-4359-01
A3	670-4359-03	B085201	B086804	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 4 ONLY)	80009	670-4359-03
A3	670-4359-05	B086805	B109999	CKT BOARD ASSY:READOUT CONDITIONER (OPTION 4 ONLY)	80009	670-4359-05
A3	670-6415-00	B110000		CKT BOARD ASSY:READOUT CONDITIONER (OPTION 4 ONLY)	80009	670-6415-00
A4	670-4357-00	B010100	B029999	CKT BOARD ASSY:MAIN	80009	670-4357-00
A4	670-4357-01	B030000	B079999	CKT BOARD ASSY:MAIN	80009	670-4357-01
A4	670-4357-02	B080000	B084810	CKT BOARD ASSY:MAIN	80009	670-4357-02

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4	670-4357-03	B084811	B085090	CKT BOARD ASSY:MAIN	80009	670-4357-03
A4	670-4357-04	B085091	B085200	CKT BOARD ASSY:MAIN	80009	670-4357-04
A4	670-4357-05	B085201	B086779	CKT BOARD ASSY:MAIN	80009	670-4357-05
A4	670-4357-06	B086780	B089999	CKT BOARD ASSY:MAIN	80009	670-4357-06
A4	670-6395-00	B090000		CKT BOARD ASSY:MAIN	80009	670-6395-00
A5	670-4362-00			CKT BOARD ASSY:READOUT SWITCH	80009	670-4362-00
A6	670-4363-00			CKT BOARD ASSY:ALARM SWITCH	80009	670-4363-00
A7	670-4361-00	B010100	B086152	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-00
	----- -----			(STANDARD ONLY)		
A7	670-4361-01	B086153	B086779	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-01
	----- -----			(STANDARD ONLY)		
A7	670-4361-02	B086780	B099999	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-02
	----- -----			(STANDARD ONLY)		
A7	670-6759-00	B100000		CKT BOARD ASSY:DVM	80009	670-6759-00
	----- -----			(STANDARD ONLY)		
A7	670-4361-00	B010100	B086152	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-00
	----- -----			(OPTION 2 ONLY)		
A7	670-4361-01	B086153	B086799	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-01
	----- -----			(OPTION 2 ONLY)		
A7	670-4361-02	B086800	B099999	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-02
	----- -----			(OPTION 2 ONLY)		
A7	670-6759-00	B100000		CKT BOARD ASSY:DVM	80009	670-6759-00
	----- -----			(OPTION 2 ONLY)		
A7	670-4361-00	B010100	B086152	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-00
	----- -----			(OPTION 4 ONLY)		
A7	670-4361-01	B086153	B086803	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-01
	----- -----			(OPTION 4 ONLY)		
A7	670-4361-02	B086804	B099999	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-02
	----- -----			(OPTION 4 ONLY)		
A7	670-6759-00	B100000		CKT BOARD ASSY:DVM	80009	670-6759-00
	----- -----			(OPTION 4 ONLY)		
A7	670-4361-00	B010100	B086152	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-00
	----- -----			(OPTION 21 ONLY)		
A7	670-4361-01	B086153	B086774	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-01
	----- -----			(OPTION 21 ONLY)		
A7	670-4361-02	B086775	B099999	CKT BOARD ASSY:DIGITAL VOLTMETER	80009	670-4361-02
	----- -----			(OPTION 21 ONLY)		
A7	670-6759-00	B100000		CKT BOARD ASSY:DVM	80009	670-6759-00
	----- -----			(OPTION 21 ONLY)		
A8	670-4360-00			CKT BOARD ASSY:DISPLAY	80009	670-4360-00
A9	670-4757-00	XB041350		CKT BOARD ASSY:FUSE HOLDER	80009	670-4757-00
BT714	119-0441-00	B010100	B041349	BATTERY SET:"D" CELL	80009	119-0441-00
	----- -----			(CONSISTS OF (4) 146-0023-00. STANDARD ONLY)		
BT714	119-0441-01	B041350	B079999	BATTERY SET:"D" CELL	80009	119-0441-01
	----- -----			(CONSISTS OF (4) 146-0023-00. STANDARD ONLY)		
BT714	119-0443-01	B080000		BATTERY SET:"F" CELL	80009	119-0443-01
	----- -----			(CONSISTS OF (4) 146-0024-00. STANDARD ONLY)		
BT714	119-0443-00	B010100	B041349	BATTERY SET:"F" CELL	80009	119-0443-00
	----- -----			(CONSISTS OF (4) 146-0024-00.OPTION 3 ONLY)		
BT714	119-0443-01	B043350	B079999X	BATTERY SET:"F" CELL	80009	119-0443-01
	----- -----			(CONSISTS OF (4) 146-0024-00.OPTION 3 ONLY)		
C105	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C107	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C109	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C125	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C151	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C152	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1

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C155	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	0831085Z5E00471J
C156	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C158	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C178	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C179	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C181	285-0809-00			CAP.,FXD,PLSTC:1UF,10%,50V	56289	LP66A1A105K
C212	283-0212-00			CAP.,FXD,CER DI:2UF,20%,50V	72982	8141N064Z5U205M
C238	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C239	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C303	283-0339-00			CAP.,FXD,CER DI:0.22UF.10%,50V	72982	8131N075W5R224K
C304	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	0831085Z5E00471J
C308	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C315	283-0190-00			CAP.,FXD,CER DI:0.47UF,5%,50V	72982	8141N077X7R0474J
C324	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C325	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C327	283-0339-00			CAP.,FXD,CER DI:0.22UF.10%,50V	72982	8131N075W5R224K
C328	283-0341-00			CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8121N153X7R0473K
C367	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C373	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C382	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C384	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C388	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
C389	283-0111-00 ----- -----	XB086157		CAP.,FXD,CER DI:0.1UF,20%,50V (STANDARD ONLY)	72982	8121-N088Z5U104M
C389	283-0111-00 ----- -----	XB086142		CAP.,FXD,CER DI:0.1UF,20%,50V (OPTION 21 ONLY)	72982	8121-N088Z5U104M
C408	283-0211-00	XB020610		CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N210X7R0104K
C410	283-0211-00	XB020610		CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N210X7R0104K
C412	283-0211-00	XB020610		CAP.,FXD,CER DI:0.1UF,10%,200V	72982	8141N210X7R0104K
C414	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C417	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
C422	290-0290-00			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	30D472
C423	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C441	290-0290-00			CAP.,FXD,ELCTLT:10UF,20%,25V	56289	30D472
C442	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075E474M
C443	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C444	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C445	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C446	290-0721-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C451	290-0721-00			CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C454	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C455	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C459	290-0527-00	B010100	B042309	CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C459	290-0721-00	B042310		CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C462	281-0512-00			CAP.,FXD.CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C464	290-0721-00			CAP.,FXD.ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C466	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C475	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C477	283-0238-00			CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C483	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C485	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C491	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C613	285-0627-00	XB090000		CAP.,FXD,PLSTC:0.0033UF,5%,100V	56289	410P33251
C614	290-0722-00	B010100	B089999X	CAP.,FXD.ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C615	283-0111-00	B010100	B089999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C615	281-0814-00	B090000		CAP.,FXD,CER DI:100PF,10%,100V	04222	GC70-1-A101K
C618	290-0536-00	B010100	B089999X	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL

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C620	283-0067-00	B010100	B089999X	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C623	281-0519-00	B010100	B089999X	CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C624	281-0525-00	B010100	B089999X	CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C625	281-0525-00	B010100	B089999X	CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C626	283-0197-00	XB084811	B089999X	CAP.,FXD,CER DI:470PF,5%,100V	72982	8121N075C0G0471J
C627	281-0519-00	B010100	B089999	CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C627	281-0826-00	B090000		CAP.,FXD,CER DI:2200PF,5%,100V	16546	C41A222K
C628	281-0525-00	B010100	B089999	CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C628	281-0812-00	B090000		CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
C629	281-0525-00	B010100	B089999	CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C629	281-0788-00	B090000		CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C630	281-0775-00	XB090000		CAP.,FXD.CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C631	283-0180-00	XB084811	B089999X	CAP.,FXD,CER DI:5600PF,20%,200V	72982	8121N204 E 562M
C632	281-0525-00	B010100	B089999	CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C632	281-0826-00	B090000		CAP.,FXD,CER DI:2200PF,5%,100V	16546	C41A222K
C633	281-0525-00	B010100	B089999	CAP.,FXD.CER DI:470PF,+/-94PF,500V	04222	7001-1364
C633	281-0788-00	B090000		CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C634	281-0772-00	XB090000		CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C635	281-0812-00	XB090000		CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
C639	283-0067-00	B010100	B089999X	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C645	283-0180-00	XB084811	B089999X	CAP.,FXD,CER DI:5600PF,20%,200V	72982	8121N204 E 562M
C646	281-0772-00	XB090000		CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C649	283-0067-00	B010100	B086779X	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
	----- -----			(STANDARD ONLY)		
C649	283-0067-00	B010100	B086954X	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
	----- -----			(OPTION 2 ONLY)		
C649	283-0067-00	B010100	B086934X	CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
	----- -----			(OPTION 4 ONLY)		
C649	283-0067-00	B010100	B086774X	CAP.,FXD.CER DI:0.001UF,10%,200V	72982	835-515B102K
	----- -----			(OPTION 21 ONLY)		
C652	281-0525-00	B010100	B089999X	CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C654	283-0111-00	B010100	B089999X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C656	290-0534-00	B010100	B089999X	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C658	283-0238-00	B010100	B089999X	CAP.,FXD,CER DI:0.01UF,10%,50V	72982	8121N075X7R0103K
C659	290-0536-00	XB090000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C661	281-0773-00	XB090000		CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C662	281-0815-00	XB090000		CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
C663	285-0784-03	B010100	B089999X	CAP.,FXD,PLSTC:10.1UF,5%,25V	80009	285-0784-03
C671	281-0775-00	XB090000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C684	281-0763-00	XB090000		CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C688	281-0763-00	XB090000		CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C691	290-0722-01	XB090000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C693	283-0003-00	B010100	B089999X	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C694	283-0003-00	B010100	B089999X	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C696	281-0773-00	XB090000		CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C697	281-0773-00	XB090000		CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C712	283-0111-00	B010100	B089999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C712	281-0775-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C713	290-0722-00	B010100	B089999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C713	290-0722-01	B090000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C722	290-0436-00	B010100	B085084	CAP.,FXD,ELCTLT:10,000UF,20%,10V	56289	68D10467
C722	290-0851-00	B085085		CAP.,FXD,ELCTLT:10,000UF,+100-10%,15V	90201	PFP 14DR2A3PA
C723	290-0536-00	B010100	B089999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C723	290-0536-01	B090000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C724	290-0536-00	B010100	B089999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C724	290-0536-01	B090000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C732	283-0003-00	B010100	B089999	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z

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C732	290-0773-00	B090000		CAP.,FXD,ELCTLT:1000UF,+50-10%,10V	0000L	ECE-B10Z1000
C733	283-0111-00	B010100	B089999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C733	281-0775-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C739	283-0003-00	B010100	B089999	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C739	281-0773-00	B090000		CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C745	290-0722-00	B010100	B089999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C745	290-0722-01	B090000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C746	283-0111-00	B010100	B089999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C746	281-0775-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C755	290-0536-00	B010100	B089999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C755	290-0536-01	B090000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C764	283-0111-00	B010100	B089999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C764	281-0775-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C802	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
C803	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
C804	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
C805	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
C806	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
C807	283-0280-00			CAP.,FXD,CER DI:2200PF,10%,2000V	56289	562CBA202EH222KA
C811	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	72982	0841545Z5V00203Z
C812	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	72982	0841545Z5V00203Z
C815	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C817	290-0721-00	B010100	B089999	CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C817	290-0721-01	B090000		CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC(ADVISE)
C821	290-0726-00	B010100	B089999	CAP.,FXD,ELCTLT:220UF,20%,10V	56289	196D227X0010TE3
C821	290-0726-01	B090000		CAP.,FXD,ELCTLT:220UF,20%,10V	90201	21-50137-01
C822	290-0726-00	B010100	B089999	CAP.,FXD,ELCTLT:220UF,20%,10V	56289	196D227X0010TE3
C822	290-0726-01	B090000		CAP.,FXD,ELCTLT:220UF,20%,10V	90201	21-50137-01
C825	290-0726-00	B010100	B089999	CAP.,FXD,ELCTLT:220UF,20%,10V	56289	196D227X0010TE3
C825	290-0726-01	B090000		CAP.,FXD,ELCTLT:220UF,20%,10V	90201	21-50137-01
C826	290-0726-00	B010100	B089999	CAP.,FXD,ELCTLT:220UF,20%,10V	56289	196D227X0010TE3
C826	290-0726-01	B090000		CAP.,FXD,ELCTLT:220UF,20%,10V	90201	21-50137-01
C828	290-0721-00	B010100	B089999	CAP.,FXD,ELCTLT:100UF,20%,20V	56289	196D107X0020TE3
C828	290-0721-01	B090000		CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC(ADVISE)
C832	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C843	283-0111-00	B010100	B089999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C843	281-0775-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C1029	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1037	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1037	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1040	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1040	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C1044	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1044	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1046	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1046	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C1051	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1051	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1061	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1061	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1080	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1080	290-0534-00	B110000		CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1090	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
C1110	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1110	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1112	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1112	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)

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C1114	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1114	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1116	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1116	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C1120	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1120	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1122	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1122	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1124	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1124	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1126	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1126	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C1200	290-0572-00			CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
C1201	281-0815-00	XB110000		CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
C1202	285-1096-00	XB110000		CAP.,FXD,PLSTC:1UF,10%,100V	14752	230B1B105K
C1207	290-0572-00	XB110000		CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
C1215	285-1097-00	B010100	B109999X	CAP.,FXD,PLSTC:0.47UF,10%,100V	14752	230B1B474K
C1237	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1237	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C1240	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1240	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,10V	90201	TDC(ADVISE)
C1244	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1244	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC(ADVISE)
C1245	290-0722-00	B010100	B109999	CAP.,FXD,ELCTLT:100UF,20%,10V	56289	196D107X0010PE3
C1245	290-0722-01	B110000		CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC(ADVISE)
C1247	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1247	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,10V	90201	TDC(ADVISE)
C1410	290-0534-00	B010100	B020184	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C1410	290-0536-00	B020185	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1410	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,10V	90201	TDC(ADVISE)
C1412	290-0536-00	XB020185	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1412	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,10V	90201	TDC(ADVISE)
C1413	283-0111-00	XB110000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1520	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1520	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,10V	90201	TDC(ADVISE0
C1528	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1535	290-0536-00	B010100	B109999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C1535	290-0536-01	B110000		CAP.,FXD,ELCTLT:10UF,20%,10V	90201	TEC(ADVISE)
C1538	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C1541	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2302	281-0775-00	XB100000		CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C2307	290-0512-00	B010100	B099999	CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C2307	285-0808-00	B100000		CAP.,FXD,PLSTC:0.1UF,10%,50V	56289	LP66A1A104K004
C2308	285-0808-00	XB100000		CAP.,FXD,PLSTC:0.1UF,10%,50V	56289	LP66A1A104K004
C2309	290-0536-00	B010100	B099999X	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2321	283-0057-00	XB100000		CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C2322	283-0003-00	XB100000		CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2323	283-0057-00	XB100000		CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C2332	290-0534-00	B010100	B099999X	CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2335	290-0536-00	B010100	B099999	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2335	283-0003-00	B100000		CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2336	285-1096-00	B010100	B099999X	CAP.,FXD,PLSTC:1UF,10%,100V	14752	230B1B105K
C2337	290-0536-00	B010100	B099999X	CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2353	283-0065-00	B010100	B099999X	CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-518-Z5D0102J
C2378	283-0660-00	B010100	B099999X	CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
C2382	285-0598-00	B010100	B099999X	CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	61F10AC103
C2390	283-0057-00	B010100	B099999X	CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10

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C2391	290-0512-00	XB100000		CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C2392	283-0003-00	B010100	B099999X	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2393	283-0057-00	B010100	B099999X	CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C2394	290-0534-00	XB100000		CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2396	283-0003-00	B010100	B099999	CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C2936	281-0813-00	B100000		CAP.,FXD CER DI:0.047UF,20%,50V	04222	GC705-E-473M
C2397	290-0534-00	XB100000		CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
CR107	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR109	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR114	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR116	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	03508	DE140
CR130	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR151	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR152	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR153	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR154	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR162	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR199	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR200	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR205	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR208	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR212	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR213	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR215	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR216	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR313	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR314	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR315	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR332	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR333	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR335	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR336	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR338	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR339	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR366	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR367	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR384	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR401	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR414	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR415	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR416	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR418	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR419	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR434	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR435	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR436	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR437	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR447	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR450	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR451	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR452	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR455	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR457	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR460	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR461	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR462	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR465	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR470	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR471	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR472	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR473	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR475	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR476	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR478	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR480	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR482	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR483	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR485	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR487	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR492	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR493	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR494	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR496	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR497	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR498	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR614	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR615	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR617	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR621	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR622	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR623	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR624	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR625	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR627	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR628	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR629	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR634	152-0107-03	XB084811		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR635	152-0107-03	XB090000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR638	152-0107-03	XB090000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR639	152-0107-03	XB090000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR641	152-0107-03	B010100	B089999X	SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR642	152-0107-03	B010100	B089999X	SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR643	152-0107-03	B010100	B089999X	SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR644	152-0107-03	B010100	B089999X	SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR646	152-0107-03	XB084811		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR648	152-0107-03	XB090000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR651	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR652	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR653	152-0141-02	XB084811		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR654	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR655	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR656	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR657	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR658	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR659	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR669	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR683	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR684	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR685	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR686	152-0141-02	B010100	B089999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR687	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR688	152-0141-02	XB090000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR703	152-0406-00			SEMICOND DEVICE:SILICON,200V,3A	80009	152-0406-00

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CR704	152-0406-00			SEMICOND DEVICE:SILICON,200V,3A	80009	152-0406-00
CR710	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR713	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR714	152-0423-00			SEMICOND DEVICE:SILICON,400V,3A	04713	1N5000
CR715	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR716	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR722	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR727	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR733	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR752	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR756	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR762	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR763	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR764	152-0141-02	XB030000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR765	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR766	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR802	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
CR803	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
CR804	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
CR805	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
CR806	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
CR807	152-0170-00			SEMICOND DEVICE:SILICON,1500V,10UA	80009	152-0170-00
CR811	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR812	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR815	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR816	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR817	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR818	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR821	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR822	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR825	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR826	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR827	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR828	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR831	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR832	152-0107-03			SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR841	152-0066-00	XB074200		SEMICOND DEVICE:SILICON,400V,750MA	14433	LG4016
CR842	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR843	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR844	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR845	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR846	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR847	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR848	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1005	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1007	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1008	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1009	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1013	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1015	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1017	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1019	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1027	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1033	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1034	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1051	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1061	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR1090	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1230	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1232	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1414	152-0141-02	XB110000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1434	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1435	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1520	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1525	152-0141-02	B010100	B109999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1535	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1536	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1548	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1555	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2309	152-0141-02	B010100	B099999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2322	152-0107-03	XB100000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR2323	152-0107-03	XB100000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR2324	152-0107-03	XB100000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR2325	152-0107-03	XB100000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR2331	152-0141-02	B010100	B099999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2334	152-0141-02	B010100	B099999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2340	152-0141-02	B010100	B099999X	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2372	152-0141-02	XB100000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2373	152-0061-00	B010100	B099999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2376	152-0141-02	XB100000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2378	152-0141-02	XB100000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2380	152-0141-02	XB100000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2383	152-0061-00	B010100	B099999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2387	152-0061-00	B010100	B099999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2388	152-0061-00	B010100	B099999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2391	152-0107-03	XB100000		SEMICOND DEVICE:SILICON,375V,400MA,SEL	80009	152-0107-03
CR2392	152-0107-00	B010100	B099999X	SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR2393	152-0107-00	B010100	B099999X	SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR2395	152-0107-00	B010100	B099999X	SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR2396	152-0107-00	B010100	B099999X	SEMICOND DEVICE:SILICON,400V,400MA	01295	G727
CR2397	152-0061-00	B010100	B099999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR2399	152-0061-00	B010100	B099999X	SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
DS105	150-0173-00			LAMP,GLOW:LKG LESS THAN1 NA	08806	C2A-T
DS107	150-0173-00			LAMP,GLOW:LKG LESS THAN1 NA	08806	C2A-T
DS109	150-0173-00			LAMP,GLOW:LKG LESS THAN1 NA	08806	C2A-T
DS213	150-1031-00			LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
DS628	150-1031-00	XB090000		LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
DS629	150-1031-00	XB090000		LT EMITTING DIO:RED,650NM,40MA MAX	53184	XC209R
DS1585	150-0123-01			LAMP,CARTRIDGE:14V,0.023A,YELLOW LENS	55292	71326-06
F701	159-0031-00			FUSE,CARTRIDGE:3AG,0.4A,250V,SLOW-BLOW	71400	MDL 4/10
	----- -----			(USED IN STANDARD 115V OPERATION)		
F701	159-0044-00			FUSE,CARTRIDGE:3AG,0.2A,250V,SLOW-BLOW	71400	MDL 2/10
	----- -----			(USED IN OPTIONAL 230V OPERATION)		
F713	159-0145-00	XB041350		FUSE,CARTRIDGE:15A,32V,10 SECONDS	75915	276015
F714	159-0145-00	XB041350		FUSE,CARTRIDGE:15A,32V,10 SECONDS	75915	276015
J100	131-1378-00	B010100	B084999	CONNECTOR,RCPT,:5 CONTACT	02660	7-8934
J100	131-1378-01	B085000		CONNECTOR,RCPT:5 CONTACT	80009	131-1378-01
J401	131-1375-00			CONN,RCPT,ELEC:FLANGE MT,6 CONT,FEMALE	02660	MS3102A
J412	131-1376-00			CONNECTOR,RCPT,:4 CONTACT	81312	M43-LRN
J603	131-1862-00			JACK,TELEPHONE:	82389	112B
J605	131-1862-00			JACK,TELEPHONE:	82389	112B
J620A	136-0658-00			SKT,PL-IN ELEK:CKT BOARD,3 CONTACT	00779	5-38D949-3
J620B	136-0558-00			SOCKET,PLUG-IN:6 CONTACT	00779	5-380949-6

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
J621A	136-0559-00			SOCKET,PLUG-IN:10 PIN,FEMALE	00779	6-380949-0
J621B	136-0558-00			SOCKET,PLUG-IN:6 CONTACT	00779	5-380949-6
J623A	136-0559-00			SOCKET,PLUG-IN:10 PIN,FEMALE	00779	6-380949-0
J623B	136-0558-00			SOCKET,PLUG-IN:6 CONTACT	00779	5-380949-6
J625A	136-0559-00			SOCKET,PLUG-IN:10 PIN,FEMALE	00779	6-380949-0
J625B	136-0558-00			SOCKET,PLUG-IN:6 CONTACT	00779	5-380949-6
J1410	131-1863-00			JACK,TELEPHONE:STD 0.25,5 COND DBL-CL CKT	82389	11413
J1582	131-1862-00			JACK,TELEPHONE:	82389	112B
K721	148-0091-00	B010100	B089999	RELAY,ARMATURE:4 FORM C,6VDC,2A,125VAC	77342	R10-E1-Y4-V52
K721	148-0112-00	B090000		RELAY,ARMATURE:SPDT,6VDC,5A	94696	W65RPCX-1
L840	119-0468-00	B010100	B020509	COIL,TUBE DEFL:CRT YOKE	80009	119-0468-00
L840	119-0468-01	B020510	B089999	COIL,TUBE DEFL:CRT YOKE	80009	119-0468-01
L840	119-0950-00	B090000		COIL,TUBE DEFL:CRT YOKE	80009	119-0950-00
LS691	119-0716-01	B010100	B089999	LOUDSPEAKER,PM:W/CABLE	80009	119-0716-01
LS691	119-0716-03	B090000		LOUDSPEAKER,PM:W/CABLE	80009	119-0716-03
M763	149-0031-03	B010100	B029999	METER,BTRY LVL:0-200VA,+/-15%	80009	149-0031-03
M763	149-0043-01	B030000	B089999	METER,BAT LEVEL:W/BRACKET,HOLDER AND CONN	80009	149-0043-01
M763	149-0043-02	B090000		METER,BAT LEVEL:W/BRACKET,HOLDER AND CONN	80009	149-0043-02
Q110A,B	151-1049-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1049-00
Q130	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q156	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q158	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q162	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q164	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q182A,B	151-1049-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1049-00
Q218	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
Q232	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q234	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q236	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q238	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q254	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	2N6027
Q308	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	2N6027
Q316	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q336	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q344	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q366	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q368	151-1022-00			TRANSISTOR:SILICON,JFE,SEL FROM 2N4392	80009	151-1022-00
Q372	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
Q382	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q384	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q386	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q450	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q452	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q460	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q462	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q492	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q620	151-0190-00	XB090000		TRANSISTOR:SILICON,NPN	07263	S032677
Q622	151-0190-00	XB090000		TRANSISTOR:SILICON,NPN	07263	S032677
Q624	151-0188-00	XB090000		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q630	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q631	151-0188-00	B010100	B089999X	TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q632	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q633	151-0190-00	B010100	B089999X	TRANSISTOR:SILICON,NPN	07263	S032677
Q634	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q635	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q636	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q637	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q638	151-0407-00			TRANSISTOR:SILICON,NPN	04713	SS2456
Q639	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q640	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q642	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q644	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q646	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q648	151-0406-00			TRANSISTOR:SILICON,PNP	01295	SGC7282
Q666	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q670	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q672	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q674	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q676	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q680	151-0190-00	XB090000		TRANSISTOR:SILICON,NPN	07263	S032677
Q684	151-0188-00	XB090000		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q688	151-0188-00	XB090000		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q692	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q694	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q712	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q714	151-0373-00	B010100	B089999X	TRANSISTOR:SILICON,PNP	80009	151-0373-00
Q715	151-0657-00	XB090000		TRANSISTOR:SILICON,PNP	04713	SJE1973
Q716	151-0373-00	B010100	B089999X	TRANSISTOR:SILICON,PNP	80009	151-0373-00
Q726	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q734	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q736	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q742	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q744	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q746	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q748	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q754	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q756	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q842	151-0350-00			TRANSISTOR:SILICON,PNP	04713	SPS6700
Q844	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1090	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	2N6027
Q1510	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1520	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1530	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q1540	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1550	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q2306	151-0444-00	XB100000		TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2307	151-0443-00	XB100000		TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2308	151-0301-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	27014	2N2907A
Q2310	151-0188-00	XB100000		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2316	151-0444-00	XB100000		TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2317	151-0443-00	XB100000		TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2326	151-0444-00	XB100000		TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2327	151-0443-00	XB100000		TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2336	151-0444-00	XB100000		TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2337	151-0443-00	XB100000		TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2340	151-0190-00	XB100000		TRANSISTOR:SILICON,NPN	07263	S032677
Q2341	151-0444-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2342	151-0444-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2343	151-0444-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2344	151-0444-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	80009	151-0444-00
Q2345	151-0443-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	80009	151-0443-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q2346	151-0443-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2347	151-0443-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2348	151-0443-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	80009	151-0443-00
Q2351	151-0347-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	56289	2N5551
Q2352	151-0347-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	56289	2N5551
Q2353	151-0347-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	56289	2N5551
Q2354	151-0347-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	56289	2N5551
Q2355	151-0347-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	56289	2N5551
Q2356	151-0347-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	56289	2N5551
Q2368	151-0188-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2370	151-0190-00	B010100	B099999X	TRANSISTOR:SILICON,NPN	07263	S032677
Q2372	151-0437-00	XB100000		TRANSISTOR:SILICON,NPN,SEL FROM 2N5769	80009	151-0437-00
Q2373	151-0190-00	B010100	B099999	TRANSISTOR:SILICON,NPN	07263	S032677
Q2373	151-0347-00	B100000		TRANSISTOR:SILICON,NPN	56289	2N5551
Q2375	151-0188-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2376	151-0188-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2378	151-0188-00	B010100	B099999X	TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q2382	151-0347-00	XB100000		TRANSISTOR:SILICON,NPN	56289	2N5551
Q2383	151-0347-00	XB100000		TRANSISTOR:SILICON,NPN	56289	2N5551
Q2388	151-0301-00	XB100000		TRANSISTOR:SILICON,PNP	27014	2N2907A
R104	314-0011-00			RES.,FXD,FILM:10G OHM,30%,0.5W	01121	EBH1093
R107	321-0510-00			RES.,FXD,FILM:2M OHM,1%,0.125W	91637	HFF188G20003F
R108	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R112	314-0011-00			RES.,FXD,FILM:10G OHM,30%,0.5W	01121	EBH1093
R114	321-0510-00			RES.,FXD,FILM:2M OHM,1%,0.125W	91637	HFF188G20003F
R115	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R117	321-0419-00			RES.,FXD,FILM:226K OHM,1%,0.125W	91637	MFF1816G22602F
R120	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R125	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R127	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R130	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R133	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R136	321-0419-00			RES.,FXD,FILM:226K OHM,1%,0.125W	91637	MFF1816G22602F
R138	322-0222-00			RES.,FXD,FILM:2K OHM,1%,0.25W	75042	CEBTO-2001F
R154	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R155	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R160	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R162	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R165	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R170	311-1244-00			RES.,VAR,NONWIR:100 OHM,10%,0.50W	32997	3386X-T07-101
R172	323-0085-00			RES.,FXD,FILM:75 OHM,1%,0.50W	91637	MFF1226G75R00F
R175	322-0193-00			RES.,FXD,FILM:1K OHM,1%,0.25W	75042	CEBTO-1001F
R178	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R179	321-0296-00			RES.,FXD,FILM:11.8K OHM,1%,0.125W	91637	MFF1816G11801F
R181	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R183	321-0291-00			RES.,FXD,FILM:10.5K OHM,1%,0.125W	91637	MFF1816G10501F
R184	311-1238-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	72X-27-0-502K
R185	311-1319-00			RES.,VAR,NONWIR:10K OHM,10%,0.75W	73138	89-126-1
R186	321-0194-00			RES.,FXD,FILM:1.02K OHM,1%,0.125W	91637	MFF1816G10200F
R187	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R188	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R189	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R193	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R195	311-1524-00	B010100	B063380	RES.,VAR,NONWIR:20K OHM,10%,1W	01121	73A1G040L203U
R195	311-1995-00	B063381		RES.,VAR,NONWIR:PNL,20K OHM,10%,1W	01121	73A1G032L203U
R196	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

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R197	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R199	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R200	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R201	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R203	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R205	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R207	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R208	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R211	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R212	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R213	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R215	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R217	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R219	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R233	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R235	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R236	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R238	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R303	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R304	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R305	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R306	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R307	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R308	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R313	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R315	315-0334-00			RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R318	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R322	315-0514-00			RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R323	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R324	307-1025-00			OPT ISOLATOR:500 OHM AT 40MA	18178	VTL-2C2
R325	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R326	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R327	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R328	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R332	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R333	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R334	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R335	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R336	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R337	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R338	316-0685-00			RES.,FXD,CMPSN:6.8M OHM,10%,0.25W	01121	CB6851
R339	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R344	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R345	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R346	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R364	316-0565-00			RES.,FXD,CMPSN:5.6M OHM,10%,0.25W	01121	CB5651
R365	315-0755-00			RES.,FXD,CMPSN:7.5M OHM,5%,0.25W	01121	CB7555
R366	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R367	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R368	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R372	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R381	315-0135-00			RES.,FXD,CMPSN:1.3M OHM,5%,0.25W	01121	CB1355
R382	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R383	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R384	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
R385	315-0364-00			RES.,FXD,CMPSN:360K OHM,5%,0.25W	01121	CB3645
R386	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255

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R387	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R388	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R400	321-0272-07			RES.,FXD,FILM:6.65K OHM,0.1%,0.125W	91637	MFF1816C66500B
R401	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R402	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R403	321-0993-07			RES.,FXD,FILM:90K OHM,0.1%,0.125W	91637	MFF1816C90001B
R404	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R405	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R408	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R409	321-0385-04			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816D10002B
R412	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R413	311-1856-00			RES.,VAR,NONWIR:PNL,2.5M OHM,1W,4PST	01121	14M352
	----- -----			(FURNISHED AS A UNIT WITH S413)		
R414	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R415	321-0408-00			RES.,FXD,FILM:174K OHM,1%,0.125W	91637	MFF1816G17402F
R417	311-1521-00			RES.,VAR,NONWIR:100K OHM,20%,1W	01121	73A1G032L104M
R418	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R419	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R422	321-0385-04			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816D10002B
R423	321-0385-04			RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816D10002B
R424	321-0807-01			RES.,FXD,FILM:900K OHM,0.5%,0.125W	91637	MFF1816G90002D
R425	321-0807-01			RES.,FXD,FILM:900K OHM,0.5%,0.125W	91637	MFF1816G90002D
R426	321-0618-00			RES.,FXD,FILM:250K OHM,1%,0.125W	91637	MFF1816G25002F
R427	321-0618-00			RES.,FXD,FILM:250K OHM,1%,0.125W	91637	MFF1816G25002F
R428	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R430	321-1648-00			RES.,FXD,FILM:600K OHM,1%,0.125W	91637	MFF1816G60002F
R431	321-1683-07			RES.,FXD,FILM:44.44K OHM,0.125W	91637	MFF1816C44441B
R432	321-0756-04			RES.,FXD,FILM:50K OHM,0.1%,0.125W	91637	MFF1816D50001B
R433	321-0756-04			RES.,FXD,FILM:50K OHM,0.1%,0.125W	91637	MFF1816D50001B
R435	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R436	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R437	321-0648-04			RES.,FXD,FILM:500K OHM,0.1%,0.125W	91637	CMF110216D5002B
R438	321-0648-04			RES.,FXD,FILM:500K OHM,0.1%,0.125W	91637	CMF110216D5002B
R442	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R443	321-0361-00			RES.,FXD,FILM:56.2K OHM,1%,0.125W	91637	MFF1816G56201F
R444	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R446	315-0203-00	B010100	B020649	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2Q35
R446	315-0243-00	B020650		RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R447	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R448	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R449	315-0105-00	B010100	B020649	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R449	315-0125-00	B020650		RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R451	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R452	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R453	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R454	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R455	321-0387-00			RES.,FXD,FILM:105K OHM,1%,0.125W	91637	MFF1816G10502F
R456	311-1336-00			RES.,VAR,NONWIR:100K OHM,0.50W	02111	43P104
R457	321-0392-00			RES.,FXD,FILM:118K OHM,1%,0.125W	91637	MFF1816G11802F
R458	321-0433-00			RES.,FXD,FILM:316K OHM,1%,0.125W	91637	MFF1816G31602F
R459	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R461	321-0932-03			RES.,FXD,FILM:2.5K OHM,0.25%,0.125W	91637	MFF1816D25000C
R462	321-0932-03			RES.,FXD,FILM:2.5K OHM,0.25%,0.125W	91637	MFF1816D25000C
R463	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R464	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R465	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R466	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

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R472	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R473	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R474	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R475	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R476	315-0623-00	B010100	B020739	RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R476	315-0623-00	B020740		RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
	----- -----			(NOMINAL VALUE,SELECTED)		
R477	315-0125-00	B010100	B020739	RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R477	315-0125-00	B020740		RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
	----- -----			(NOMINAL VALUE,SELECTED)		
R478	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R481	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R482	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R483	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R484	315-0164-00			RES.,FXD,CMPSN:160K OHM,5%,0.25W	01121	CB1645
R485	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R486	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R491	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R492	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R493	321-0378-00			RES.,FXD,FILM:84.5K OHM,1%,0.125W	91637	MFF1816G84501F
R495	311-1246-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	02111	63X-503-T602
R498	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R499	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R601	311-1226-00	XB090000		RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R602	321-0297-00	XB090000		RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R603	321-0612-02			RES.,FXD,FILM:500 OHM,0.5%,0.125W	91637	MFF1816D500R0D
R604	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R605	321-0612-02	B010100	B089999	RES.,FXD,FILM:500 OHM,0.5%,0.125W	91637	MFF1816D500R0D
R605	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R607	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R608	315-0104-00	XB090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R609	321-0366-00	XB090000		RES.,FXD,FILM:63.4K OHM,1%,0.125W	91637	MFF1816G63401F
R612	321-0001-00	B010100	B089999	RES.,FXD,FILM:10 OHM,1%,0.125W	75042	CEAT0-10R00F
R612	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R613	321-0030-00	B010100	B089999	RES.,FXD,FILM:20 OHM,1%,0.125W	91637	MFF1816G20R00F
R613	321-0373-00	B090000		RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R614	321-0420-00	B010100	B089999	RES.,FXD,FILM:232K OHM,1%,0.125W	91637	MFF1816G23202F
R614	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R615	315-0105-00	B010100	B089999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R615	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R616	315-0625-00	B010100	B089999	RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R616	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R617	315-0334-00	B010100	B089999	RES.,FXD,CMPSN:330K OHM,5%,0.25W	01121	CB3345
R617	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R618	315-0472-00	XB084811	B089999	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R618	315-0223-00	B090000		RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R619	315-0472-00	XB084811	B089999	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R619	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R620	315-0475-00	B010100	B089999X	RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R621	315-0124-00	B010100	B089999X	RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245
R622	315-0335-00	B010100	B089999	RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R622	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R623	315-0335-00	B010100	B089999	RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R623	315-0105-00	B090000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R624	315-0104-00	B010100	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R624	315-0472-00	B090000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R625	315-0104-00	B010100	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

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R625	315-0472-00	B090000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R626	315-0105-00	B010100	B089999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R626	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R627	315-0105-00	B010100	B089999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R627	321-0275-00	B090000		RES.,FXD,FILM:7.15K OHM,1%,0.125W	24546	NA55D7151F
R628	315-0103-00	B010100	B089999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R628	315-0202-00	B090000		RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R629	315-0104-00	B010100	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R629	315-0273-00	B090000		RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R630	317-0103-00	XB084811	B089999	RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
R630	315-0472-00	B090000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R631	317-0103-00	XB084811	B089999	RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
R631	315-0105-00	B090000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R632	321-0424-00	B010100	B089999	RES.,FXD,FILM:255K OHM,1%,0.125W	91637	MFF1816G25502F
R632	321-0335-00	B090000		RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R633	321-0402-00	B010100	B089999	RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R633	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R634	315-0564-00	B010100	B089999	RES.,FXD,CMPSN:560K OHM,5%,0.25W	01121	CB5645
R634	315-0222-00	B090000		RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R635	315-0104-00	B010100	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R635	315-0473-00	B090000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R636	315-0222-00	B010100	B089999	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R636	315-0473-00	B090000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R637	315-0103-00	B010100	B089999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R637	315-0471-00	B090000		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R638	315-0473-00	B010100	B089999	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R638	315-0102-00	B090000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R639	315-0473-00	B010100	B089999X	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R640	315-0473-00	B010100	B089999	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R640	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R641	315-0473-00	B010100	B089999	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R641	315-0472-00	B090000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R642	315-0330-00	B010100	B089999	RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R642	315-0473-00	B090000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R643	315-0471-00	B010100	B089999	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R643	315-0330-00	B090000		RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R644	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R645	315-0330-00	B010100	B089999	RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R645	311-1222-00	B090000		RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
R646	321-0142-00			RES.,FXD,FILM:294 OHM,1%,0.125W	91637	MFF1816G294R0F
R647	311-1222-00	B010100	B089999	RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
R647	308-0574-00	B090000		RES.,FXD,WW:10 OHM,5%,2W	91637	RS2B162K10R00J
R648	308-0574-00	B010100	B089999	RES.,FXD,WW:10 OHM,5%,2W	91637	RS2B162K10R00J
R648	315-0330-00	B090000		RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R649	315-0102-00	B010100	B089999	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R649	315-0473-00	B090000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R650	315-0474-00	B010100	B089999	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R650	315-0563-00	B090000		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R651	315-0272-00	XB084811	B089999X	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R652	315-0105-00	B010100	B089999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R652	315-0472-00	B090000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R653	315-0105-00	B010100	B020739	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R653	315-0185-00	B020740	B089999	RES.,FXD,CMPSN:1.8M OHM,5%,0.25W	01121	CB1855
R653	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R654	315-0105-00	B010100	B084810	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R654	315-0683-00	B084811	B089999	RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R654	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

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R655	315-0272-00	XB085201	B089999	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R655	315-0563-00	B090000		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R656	315-0625-00	B010100	B089999	RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R656	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R657	315-0473-00	B010100	B089999	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R657	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R658	315-0625-00	B010100	B020739	RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R658	315-0625-00	B020740	B089999	RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R658	315-0754-00	B090000		RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
R659	315-0223-00	B010100	B089999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R659	315-0393-00	B090000		RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R660	315-0105-00	B010100	B089999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R660	307-0573-00	B090000		RES NTWK,FXD FI:(9)100K,(11)200K OHM,2%	01121	314 L10104
R661	321-0431-00	B010100	B089999X	RES.,FXD,FILM:301K OHM,1%,0.125W	91637	MFF1816G30102F
R662	321-0414-00	B010100	B089999	RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
R662	315-0102-00	B090000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R663	321-0402-00	B010100	B089999	RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R663	315-0102-00	B090000		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R664	321-0402-00	B010100	B089999	RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R664	315-0563-00	B090000		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R665	321-0402-00	B010100	B089999	RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R665	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R666	321-0402-00	B010100	B089999	RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R666	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R667	311-1232-00	B010100	B089999	RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R667	311-1231-00	B090000		RES.,VAR,NONWIR:25K OHM,20%,0.50W	32997	3386F-T04-253
R668	321-0385-00	B010100	B089999	RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R668	321-0352-00	B090000		RES.,FXD,FILM:45.3K OHM,1%,0.125W	91637	MFF1816G45301F
R669	315-0474-00	B010100	B089999	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R669	315-0105-00	B090000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R670	315-0105-00	B010100	B089999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R670	315-0913-00	B090000		RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R671	311-1235-00	B010100	B089999	RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R671	311-1228-00	B090000		RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R672	321-0452-00	B010100	B089999	RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R672	321-0420-00	B090000		RES.,FXD,FILM:232K OHM,1%,0.125W	91637	MFF1816G23202F
R673	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R674	321-0385-00	B010100	B089999	RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R674	315-0153-00	B090000		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R675	321-0452-00	B010100	B089999	RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R675	321-0363-00	B090000		RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
R676	321-0385-00	B010100	B089999	RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R676	321-0365-00	B090000		RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R677	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R678	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R679	315-0102-00	B010100	B089999X	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R680	315-0102-00	B010100	B089999X	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R681	317-0103-00	XB084811	B089999	RES.,FXD,CMPSN:10K OHM,5%,0.125W	01121	BB1035
R681	315-0105-00	B090000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R682	315-0223-00	XB090000		RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R683	315-0103-00	XB090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R684	315-0223-00	B010100	B089999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R684	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R688	315-0105-00	XB090000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R689	315-0474-00	XB090000		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R690	315-0223-00	XB090000		RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R691	315-0105-00	XB090000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055

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R692	311-1521-00			RES.,VAR,NONWIR:100K OHM,20%,1W	01121	73A1G032L104M
R693	315-0104-00	B010100	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R693	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R694	315-0104-00	B010100	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R694	315-0103-00	B090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R695	311-1521-00			RES.,VAR,NONWIR:100K OHM,20%,1W	01121	73A1G032L104M
R696	315-0104-00	XB090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R697	315-0154-00	B010100	B089999	RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R697	315-0104-00	B090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R698	315-0154-00	XB090000		RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R710	302-0100-00	B010100	B089999	RES.,FXD,CMPSN:10 OHM,10%,0.50W	01121	EB1001
R710	301-0360-00	B090000		RES.,FXD,CMPSN:36 OHM,5%,0.5W	01121	EB3605
R711	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R712	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R714	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R715	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R716	308-0686-00	B010100	B079999	RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R716	308-0459-00	B080000	B085090	RES.,FXD,WW:1.1 OHM,5%,3W	91637	CW2B-D1R100J
R716	308-0365-00	B085091		RES.,FXD,WW:1.5 OHM,5%,3W	91637	CW2B-1R500J
R718	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R721	317-0100-00	XB090000		RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R722	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R723	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R724	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R725	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R726	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R727	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R731	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R732	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R733	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R734	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R735	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R736	321-0333-00			RES.,FXD,FILM:28.7K OHM,1%,0.125W	91637	MFF1816G28701F
R737	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502
R738	321-0330-00			RES.,FXD,FILM:26.7K OHM,1%,0.125W	91637	MFF1816G26701F
R739	315-0240-00			RES.,FXD,CMPSN:24 OHM,5%,0.25W	01121	CB2405
R743	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R744	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R745	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R746	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R752	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R753	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R754	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R755	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R756	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R762	315-0104-00	B010100	B029999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R762	315-0273-00	B030000		RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R763	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R764	321-0352-00	B010100	B029999	RES.,FXD,FILM:45.3K OHM,1%,0.125W	91637	MFF1816G45301F
R764	321-0408-00	B030000		RES.,FXD,FILM:174K OHM,1%,0.125W	91637	MFF1816G17402F
R765	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
R766	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R767	321-0352-00	B010100	B089999	RES.,FXD,FILM:45.3K OHM,1%,0.125W	91637	MFF1816G45301F
R767	321-0775-00	B090000		RES.,FXD,FILM:45K OHM,1%,0.125W	91637	MFF1816G45001F
R768	315-0301-00	XB090000		RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R802	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R803	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255

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R804	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R805	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R806	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R807	315-0225-00			RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R811	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R812	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R815	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R817	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R828	307-0114-00			RES.,FXD,CMPSN:6.2 OHM,5%,0.25W	01121	CB62G5
R832	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R840	315-0104-00	XB090000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R841	311-1255-00			RES.,VAR,NONWIR:2M OHM,20%,0.50W	73138	72-19-0
R842	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R843	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R844	316-0825-00			RES.,FXD,CMPSN:8.2M OHM,10%,0.25W	01121	CB8251
R845	315-0102-00	XB085201		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R846	315-0103-00	XB090000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R848	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R1002	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1002	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1003	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1004	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1005	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1006	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1007	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1008	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1009	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1009	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1013	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1013	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1015	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1015	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1017	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1017	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1020	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1020	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1021	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1021	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1022	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1022	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1023	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1024	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1025	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1026	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R1027	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R1028	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	91637	MFF1816G63400F
R1029	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R1030	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1031	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1032	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R1033	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1034	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1036	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1037	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1040	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1042	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1044	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

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R1046	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1047	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1050	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1051	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R1060	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1061	315-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R1070	321-0993-07			RES.,FXD,FILM:90K OHM,0.1%,0.125W	91637	MFF1816C90001B
R1072	321-0289-07			RES.,FXD,FILM:10K OHM,0.1%,0.125W	91637	MFF1816C10001B
R1080	315-0103-00	B010100	B109999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1080	315-0104-00	B110000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1089	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1090	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R1091	315-0272-00	XB085201		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1092	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1095	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1097	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R1114	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1116	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1118	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1124	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1126	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1128	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1200	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1209	317-0100-00	XB110000		RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1212	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1213	321-0437-00	B010100	B109999X	RES.,FXD,FILM:348K OHM,1%,0.125W	91637	MFF1816G34802F
R1214	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1215	311-1857-00			RES.,VAR,NONWIR:TRMR,200K OHM,0.5W,LINEAR	32997	3299X-R27-204
R1216	315-0102-00	XB074201	B109999	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1216	315-0363-00	B110000		RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R1217	321-0414-09	XB110000		RES.,FXD,FILM:200K OHM,1%,0.125W	24546	NE55E2003F
R1232	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1234	321-0414-04	B010100	B109999	RES.,FXD,FILM:200K OHM,0.1%,0.125W	91637	MFF1816D20002B
R1234	321-0413-00	B110000		RES.,FXD,FILM:196K OHM,1%,0.125W	91637	MFF1816G19602F
R1236	321-0414-04			RES.,FXD,FILM:200K OHM,0.1%,0.125W	91637	MFF1816D20002B
R1237	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R1238	321-0414-09	XB110000		RES.,FXD,FILM:200K OHM,1%,0.125W	24546	NE55E2003F
R1239	315-0392-00	XB110000		RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1240	321-0414-04	B010100	B109999	RES.,FXD,FILM:200K OHM,0.1%,0.125W	91637	MFF1816D20002B
R1240	321-0414-09	B110000		RES.,FXD,FILM:200K OHM,1%,0.125W	24546	NE55E2003F
R1242	315-0823-00	B010100	B109999	RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R1242	315-0683-00	B110000		RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R1244	321-0385-07	B010100	B109999	RES.,FXD,FILM:100K OHM,0.1%,0.125W	91637	MFF1816C10002B
R1244	321-0378-00	B110000		RES.,FXD,FILM:84.5K OHM,1%,0.125W	91637	MFF1816G84501F
R1245	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1247	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1248	315-0114-00			RES.,FXD,CMPSN:110K OHM,5%,0.25W	01121	CB1145
R1249	311-1860-00	XB110000		RES.,VAR,NONWIR:TRMR,10K OHM,0.50W	32997	3299X-R27-103
R1250	321-0324-00	XB110000		RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R1252	315-0625-00	B010100	B109999X	RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R1400	321-0249-09			RES.,FXD,FILM:3.83K OHM,1%,0.125W	91637	MFF1816C38300F
R1402	321-0289-09			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816C10001F
R1404	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	91637	MFF1816G30900F
R1407	321-1682-07			RES.,FXD,FILM:5.7K OHM,0.1%,0.125W	91637	MFF1816C57000B
R1408	321-0191-09			RES.,FXD,FILM:953 OHM,1%,0.125W	24546	NE55E9530F
R1410	311-1861-00			RES.,VAR,NONWIR:TRMR,1K OHM,0.50W	32997	3299X-R27-102
R1412	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B

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R1413	315-0105-00	B010100	B020184	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1413	315-0244-00	B020185	B109999	RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
R1413	315-0432-00	B110000		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R1415	315-0513-00	B010100	B020184	RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R1415	315-0123-00	B020185	B109999	RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R1415	315-0683-00	B110000		RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R1416	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R1417	315-0203-00	XB110000		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R1418	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R1419	315-0823-00	XB110000		RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R1420	311-1858-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.5W	32997	3299X-R27-101
R1422	321-0171-09			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816C590R0F
R1423	321-0202-09			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816C12400F
R1424	311-1859-00			RES.,VAR,NONWIR:TRMR,200 OHM,0.5W,LINEAR	32997	3299X-R27-201
R1427	321-0641-07			RES.,FXD,FILM:1.8K OHM,0.1%,0.125W	91637	MFF1816C18000B
R1428	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R1430	321-0137-00			RES.,FXD,FILM:261 OHM,1%,0.125W	91637	MFF1816G261R0F
R1432	321-0168-00			RES.,FXD,FILM:549 OHM,1%,0.125W	91637	MFF1816G549R0F
R1434	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
R1437	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1441	315-0104-00	B010100	B109999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1441	315-0105-00	B110000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1442	315-0103-00	XB110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1443	315-0104-00	B010100	B109999X	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1501	321-1296-03			RES.,FXD,FILM:12K OHM,0.25%,0.125W	91637	MFF1816D12001C
R1503	321-0828-03			RES.,FXD,FILM:2.4K OHM,0.25%,0.125W	91637	MFF1816D24000C
R1504	321-0211-00			RES.,FXD,FILM:1.54K OHM,1%,0.125W	91637	MFF1816G15400F
R1505	311-1865-00			RES.,VAR,NONWIR:PNL,50K OHM,1W,4PST	01121	15M011
	----- -----			(FURNISHED AS A UNIT WITH S1505)		
R1506	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R1514	321-0211-00			RES.,FXD,FILM:1.54K OHM,1%,0.125W	91637	MFF1816G15400F
R1515	311-1866-00			RES.,VAR,NONWIR:PNL,50K OHM,1W	01121	20M721
	----- -----			(FURNISHED AS A UNIT WITH S1515A,B)		
R1516	321-0189-00			RES.,FXD,FILM:909 OHM,1%,0.125W	91637	MFF1816G909R0F
R1520	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R1521	315-0272-00	XB085201		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1526	315-0104-00	B010100	B109999X	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1527	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1528	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R1530	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1533	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1534	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1535	315-0125-00			RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R1536	315-0272-00	XB085201	B109999	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R1536	315-0103-00	B110000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1537	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1538	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R1541	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1542	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1544	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1545	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1546	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1552	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1557	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R1562	315-0104-00	B010100	B109999X	RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2301	321-0213-00	B010100	B099999	RES.,FXD,FILM:1.62K OHM,1%,0.125W	91637	MFF1816G16200F
R2301	321-0249-09	B100000		RES.,FXD,FILM:3.83K OHM,1%,0.125W	91637	MFF1816C38300F

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R2302	315-0122-00	B010100	B099999	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2302	311-1861-00	B100000		RES.,VAR,NONWIR:TRMR,1K OHM,0.50W	32997	3299X-R27-102
R2303	321-0201-00	B010100	B099999	RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	MFF1816G12100F
R2303	321-1211-09	B100000		RES.,FXD,FILM:1.56K OHM,1%,0.125W	91637	MFF1816C15600F
R2304	315-0392-00	B010100	B099999	RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2304	315-0106-00	B100000		RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R2305	321-0816-03	B010100	B099999	RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R2305	315-0103-00	B100000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2306	321-1296-03	B010100	B099999X	RES.,FXD,FILM:12K OHM,0.25%,0.125W	91637	MFF1816D12001C
R2307	315-0823-00	XB100000		RES.,FXD,CMPSN:82K OHM,5%,0.25W	01121	CB8235
R2309	315-0100-00	B010100	B099999	RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2309	315-0563-00	B100000		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R2311	315-0100-00	B010100	B099999X	RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R2312	321-0193-07	B010100	B099999	RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R2312	307-0549-00	B100000		RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	MSP08A01-105J
R2313	307-0549-00	XB100000		RES,NTWK,FXD,FI:7.1M OHM,5%,2.0W	91637	MSP08A01-105J
R2314	321-0193-07	B010100	B099999X	RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R2317	321-0193-07	B010100	B099999X	RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R2318	315-0102-00	B010100	B099999X	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R2319	321-0193-07	B010100	B099999X	RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
R2322	315-0106-00	XB100000		RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R2323	315-0106-00	XB100000		RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R2325	315-0304-00	XB100000		RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R2331	315-0105-00	B010100	B099999X	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2332	311-1861-00	B010100	B099999X	RES.,VAR,NONWIR:TRMR,1K OHM,0.50W	32997	3299X-R27-102
R2333	321-1211-09	B010100	B099999	RES.,FXD,FILM:1.56K OHM,1%,0.125W	91637	MFF1816C15600F
R2333	315-0104-00	B100000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2334	311-1860-00	B010100	B099999	RES.,VAR,NONWIR:TRMR,10K OHM,0.50W	32997	3299X-R27-103
R2334	315-0105-00	B100000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2336	315-0104-00	XB100000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2337	321-0289-09	B010100	B099999	RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816C10001F
R2337	315-0105-00	B100000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2338	315-0122-00	B010100	B099999X	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2339	315-0104-00	XB100000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2340	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2340	315-0105-00	B100000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2341	315-0103-00	B010100	B099999X	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2342	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2342	315-0104-00	B100000		RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2343	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2343	315-0105-00	B100000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2344	315-0103-00	B010100	B099999X	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2345	315-0472-00	XB100000		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2346	315-0153-00	B010100	B099999X	RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2347	315-0153-00	B010100	B099999X	RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2348	315-0153-00	B010100	B099999X	RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2349	315-0153-00	B010100	B099999X	RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2350	315-0514-00	XB100000		RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R2351	315-0153-00	XB100000		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2352	315-0105-00	B010100	B099999X	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2353	315-0513-00	B010100	B099999	RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R2353	315-0103-00	B100000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2354	315-0203-00	B010100	B099999X	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2355	315-0514-00	XB100000		RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R2356	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2356	315-0153-00	B100000		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2357	315-0203-00	B010100	B099999	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035

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R2357	315-0103-00	B100000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2359	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2359	315-0514-00	B100000		RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R2360	315-0153-00	XB100000		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2361	315-0105-00	B010100	B099999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2361	315-0103-00	B100000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2362	315-0105-00	B010100	B099999X	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2363	315-0514-00	XB100000		RES.,FXD,CMPSN:510K OHM,5%,0.25W	01121	CB5145
R2364	315-0105-00	B010100	B099999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2364	315-0153-00	B100000		RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2365	315-0105-00	B010100	B099999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2365	315-0103-00	B100000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2368	315-0105-00	B010100	B099999X	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2369	315-0105-00	B010100	B099999X	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2370	315-0562-00	B010100	B099999	RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R2370	315-0275-00	B100000		RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R2372	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2372	315-0275-00	B100000		RES.,FXD,CMPSN:2.7M OHM,5%,0.25W	01121	CB2755
R2374	315-0203-00	B010100	B099999	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2374	315-0752-00	B100000		RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R2375	315-0103-00	B010100	B099999	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2375	315-0105-00	B100000		RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2376	315-0302-00	B010100	B099999	RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R2376	315-0272-00	B100000		RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2377	315-0103-00	B010100	B099999X	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2379	315-0103-00	B010100	B099999X	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2380	315-0753-00	B010100	B099999X	RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R2381	315-0682-00	XB100000		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2382	315-0363-00	B010100	B099999X	RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R2383	315-0203-00	XB100000		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2384	315-0243-00	B010100	B099999	RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R2384	315-0362-00	B100000		RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R2385	315-0473-00	XB100000		RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2386	315-0133-00	B010100	B099999X	RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R2387	315-0203-00	XB100000		RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2388	315-0105-00	B010100	B099999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2388	315-0103-00	B100000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2389	315-0243-00	B010100	B099999X	RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R2391	321-0816-03	XB100000		RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R2392	315-0106-00	B010100	B099999X	RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R2393	315-0106-00	B010100	B099999	RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R2393	315-0392-00	B100000		RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R2394	321-0269-00	XB100000		RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R2395	315-0122-00	XB100000		RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R2396	315-0304-00	B010100	B099999	RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R2396	321-0816-03	B100000		RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R2397	315-0105-00	B010100	B099999	RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2397	321-0816-03	B100000		RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R2398	315-0103-00	B010100	B099999X	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2399	315-0103-00	B010100	B099999X	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
S110	260-1545-00	B010100	B063438	SWITCH,PUSH:4 STA,2 POLE INTERLOCK	80009	260-1545-00
S110	260-1545-01	B063439		SWITCH,PUSH:4 BTN,2 POLE,ECG	80009	260-1545-01
S405	260-1814-00	B010100	B063438	SWITCH,PUSH:2/4/8PDT,1.3A,28VAC,6 BUTTON	80009	260-1814-00
S405	260-1814-01	B063439		SWITCH,PUSH:6 BTN,2,4 &8 POLE,PRESSURE	80009	260-1814-01
S413	----- -----			(FURNISHED AS A UNIT WITH R413)		
S661	260-1572-00	B010100	B063438	SWITCH,PUSH:3 STA,2 POLE,INTERLOCK	80009	260-1572-00

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S661	260-1572-01	B063439	B074200	SWITCH,PUSH:3 BTN,2 POLE,SWEEP SPEED	80009	260-1572-01
S661	260-1572-00	B074201	B084709	SWITCH,PUSH:3 STA,2 POLE,INTERLOCK	80009	260-1572-00
S661	260-1572-01	B084710		SWITCH,PUSH:3 BTN,2 POLE,SWEEP SPEED	80009	260-1572-01
S701	260-1300-01			SWITCH,SLIDE:DPDT,3A,125V	82389	11A-1354
S703	260-1486-00			SWITCH,PUSH:1 BUTTON,PB1,4P,PUSH-PUSH	80009	260-1486-00
S1425	260-1812-00			SWITCH,SLIDE:DPDT,0.5A,125VAC	82389	11P-1076
S1505	----- -----			(FURNISHED AS A UNIT WITH R1505)		
S1515A,B	----- -----			(FURNISHED AS A UNIT WITH R1515)		
S1710	260-1815-00			SWITCH,PUSH:DPDT,1A,28VAC,2 BUTTON	80009	260-1815-00
S1715						
S1850	260-1813-00			SWITCH,PUSH:DPDT,1A,28VAC,4 BUTTON	80009	260-1813-00
T155	120-0947-00			XFMR,SIGNAL:POT CORE	80009	120-0947-00
T701	120-0866-01 ----- -----	B010100	B086864	XFMR,PWR,SDN&SU: (STANDARD ONLY)	80009	120-0866-01
T701	120-0866-02 ----- -----	B086865		XFMR,PWR,SDN&SU: (STANDARD ONLY)	80009	120-0866-02
T701	120-0866-01 ----- -----	B010100	B087104	XFMR,PWR,SDN&SU: (OPTION 2 ONLY)	80009	120-0866-01
T701	120-0866-02 ----- -----	B087105		XFMR,PWR,SDN&SU: (OPTION 2 ONLY)	80009	120-0866-02
T701	120-0866-01 ----- -----	B010100	B086879	XFMR,PWR,SDN&SU: (OPTION 4 ONLY)	80009	120-0866-01
T701	120-0866-02 ----- -----	B086880		XFMR,PWR,SDN&SU: (OPTION 4 ONLY)	80009	120-0866-02
T701	120-0866-01 ----- -----	B010100	B086884	XFMR,PWR,SDN&SU: (OPTION 21 ONLY)	80009	120-0866-01
T701	120-0866-02 ----- -----	B086885		XFMR,PWR,SDN&SU: (OPTION 21 ONLY)	80009	120-0866-02
T801	120-0868-00			XFMR,INVERTER:POT CORE	80009	120-0868-00
T2301	120-1042-00	B010100	B099999X	XFMR,PWR,STU:READOUT,POT CORE	80009	120-1042-00
T2385	120-1042-00	XB100000		XFMR,PWR,STU:READOUT,POT CORE	80009	120-1042-00
U120	156-0158-00 ----- -----	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (STANDARD ONLY)	18324	MC1458V
U120	156-0158-03 ----- -----	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK (STANDARD ONLY)	80009	156-0158-03
U120	156-0158-00 ----- -----	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (OPTION 4 ONLY)	18324	MC1458V
U120	156-0158-03 ----- -----	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK (OPTION 4 ONLY)	80009	156-0158-03
U174	156-0158-00 ----- -----	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (STANDARD ONLY)	18324	MC1458V
U174	156-0158-03 ----- -----	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK (STANDARD ONLY)	80009	156-0158-03
U174	156-0158-00 ----- -----	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (OPTION 4 ONLY)	18324	MC1458V
U174	156-0158-03 ----- -----	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK (OPTION 4 ONLY)	80009	156-0158-03
U182	156-0158-00 ----- -----	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (STANDARD ONLY)	18324	MC1458V
U182	156-0158-03 ----- -----	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK (STANDARD ONLY)	80009	156-0158-03
U182	156-0158-00 ----- -----	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (OPTION 4 ONLY)	18324	MC1458V
U182	156-0158-03 ----- -----	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK (OPTION 4 ONLY)	80009	156-0158-03
U204	156-0158-00 ----- -----	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER (STANDARD ONLY)	18324	MC1458V

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U204	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(STANDARD ONLY)		
U204	156-0158-00	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(OPTION 4 ONLY)		
U204	156-0158-03	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(OPTION 4 ONLY)		
U216	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(STANDARD ONLY)		
U216	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(STANDARD ONLY)		
U216	156-0158-00	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(OPTION 4 ONLY)		
U216	156-0158-03	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(OPTION 4 ONLY)		
U324	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(STANDARD ONLY)		
U324	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(STANDARD ONLY)		
U324	156-0158-00	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(OPTION 4 ONLY)		
U324	156-0158-03	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(OPTION 4 ONLY)		
U336	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(STANDARD ONLY)		
U336	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(STANDARD ONLY)		
U336	156-0158-00	B010100	B086369	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
	----- -----			(OPTION 4 ONLY)		
U336	156-0158-03	B086370		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
	----- -----			(OPTION 4 ONLY)		
U388	156-0402-00	B010100	B086349	MICROCIRCUIT,LI:TIMER	27014	SL34829
U388	156-0402-03	B086350		MICROCIRCUIT,LI:TIMER,TESTED	80009	156-0402-03
U424	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U424	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U424	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U440	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U440	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U444	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U444	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U448	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U448	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U466	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U466	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U472	156-0289-00	B010100	B020499	MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	07263	74LS95(PC OR DC)
U472	156-0802-00	B020500		MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0802-00
U476	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U476	156-0349-03	B086350		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U615	156-0366-02	XB090000		MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
U617	156-0494-02	XB090000		MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
U619	156-0349-03	XB090000		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U620	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U620	156-0349-03	B086350		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U622	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U622	156-0349-03	B086350	B089999X	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U624	156-0289-00	B010100	B089999X	MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	07263	74LS95(PC OR DC)
U625	156-0644-00	XB090000		MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00

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U626	156-0750-00 ----- -----	B010100	B085544	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (STANDARD ONLY)	80009	156-0750-00
U626	156-0750-01 ----- -----	B085545	B089999X	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (STANDARD ONLY)	80009	156-0750-01
U626	156-0750-00 ----- -----	B010100	B085549	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (OPTION 21 ONLY)	80009	156-0750-00
U626	156-0750-01 ----- -----	B085550	B089999X	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (OPTION 21 ONLY)	80009	156-0750-01
U627	156-1152-00	XB090000		MICROCIRCUIT,DI:DUAL PRCN RETR RESET MM	80009	156-1152-00
U628	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U628	156-0158-03	B086350	B089999X	MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U629	156-0067-12	XB090000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U649	156-0067-12	XB090000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U652	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U652	156-0349-03	B086350	B089999X	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U653	156-0366-02	XB090000		MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
U655	156-0575-03	XB090000		MICROCIRCUIT,DI:3 INPUT NOR GATE,SELECTED	80009	156-0575-03
U656	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U656	156-0349-03	B086350	B089999X	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U657	156-0545-01	XB090000		MICROCIRCUIT,DI:12 BIT BINARY CNTR	04713	MC14040BCLD
U659	156-0545-01	XB090000		MICROCIRCUIT,DI:12 BIT BINARY CNTR	04713	MC14040BCLD
U661	156-1152-00	XB090000		MICROCIRCUIT,DI:DUAL PRCN RETR RESET MM	80009	156-1152-00
U662	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U662	156-0349-03	B086350	B089999X	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U664	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U664	156-0158-03	B086350	B089999X	MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U665	156-0895-00	XB090000		MICROCIRCUIT,DI:14-BIT BINARYCOUNTER	80009	156-0895-00
U668	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U668	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U764	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U764	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U1005	156-0756-00	B010100	B109999	MICROCIRCUIT,DI:BCD TO DECIMAL DECODER	80009	156-0756-00
U1005	156-0756-01	B110000		MICROCIRCUIT,DI:BCD DECIMAL DECODER	04713	MC14028BCLD
U1010	156-0513-00	B010100	B086349	MICROCIRCUIT,DI:8-CHAN MUX	80009	156-0513-00
U1010	156-0513-02	B086350		MICROCIRCUIT,DI:8-CHANNEL MUX,SEL	80009	156-0513-02
U1015	156-0366-00	B010100	B086349	MICROCIRCUIT,DI:DUAL D-TYPE F-F	80009	156-0366-00
U1015	156-0366-02	B086350		MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
U1020	156-0750-00 ----- -----	B010100	B085544	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (STANDARD ONLY)	80009	156-0750-00
U1020	156-0750-01 ----- -----	B085545	B109999	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (STANDARD ONLY)	80009	156-0750-01
U1020	156-1152-01 ----- -----	B110000		MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN (STANDARD ONLY)	80009	156-1152-01
U1020	156-0750-00 ----- -----	B010100	B085549	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (OPTION 21 ONLY)	80009	156-0750-00
U1020	156-0750-01 ----- -----	B085550	B109999	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (OPTION 21 ONLY)	80009	156-0750-01
U1020	156-1152-01 ----- -----	B110000		MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN (OPTION 21 ONLY)	80009	156-1152-01
U1025	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U1025	156-0349-03	B086350		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U1030	156-0753-00	B010100	B109999	MICROCIRCUIT,DI:EXPAN 4-W 2-INP AOI GATE	80009	156-0753-00
U1030	156-0753-01	B110000		MICROCIRCUIT,DI:EXPAN 4-W 2-INP AOI GATE	02735	CD4086BFX
U1035	156-0753-00	B010100	B109999	MICROCIRCUIT,DI:EXPAN 4-W 2-INP AOI GATE	80009	156-0753-00
U1035	156-0753-01	B110000		MICROCIRCUIT,DI:EXPAN 4-W 2-INP AOI GATE	02735	CD4086BFX
U1040	156-0350-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U1040	156-0350-02	B086350	B109999	MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02

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U1040	156-0350-05	B110000		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
U1050	156-0494-00	B010100	B086349	MICROCIRCUIT,DI:HEX INVERTER/BUFFER	80009	156-0494-00
U1050	156-0494-02	B086350		MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
U1055	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U1055	156-0349-03	B086350		MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U1060	156-0644-00	B010100	B109999	MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00
U1060	156-0644-03	B110000		MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BCLD
U1105	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U1105	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U1110	156-0067-00	B010100	B086349	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U1110	156-0067-12	B086350		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U1115	156-0495-00	B010100	B086349	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1115	156-0495-02	B086350		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U1120	156-0495-00	B010100	B086349	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1120	156-0495-02	B086350		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U1125	156-0495-00	B010100	B086349	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1125	156-0495-02	B086350		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U1130	156-0644-00	B010100	B109999	MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00
U1130	156-0644-03	B110000		MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BCLD
U1135	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U1135	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U1210	156-0750-00 ----- -----	B010100	B085544	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (STANDARD ONLY)	80009	156-0750-00
U1210	156-0750-01 ----- -----	B085545	B109999	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (STANDARD ONLY)	80009	156-0750-01
U1210	156-1152-01 ----- -----	B110000		MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN (STANDARD ONLY)	80009	156-1152-01
U1210	156-0750-00 ----- -----	B010100	B085549	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (OPTION 21 ONLY)	80009	156-0750-00
U1210	156-0750-01 ----- -----	B085550	B109999	MICROCIRCUIT,DI:DUAL MONOSTABLE MV (OPTION 21 ONLY)	80009	156-0750-01
U1210	156-1152-01 ----- -----	B110000		MICROCIRCUIT,DI:PRCN RETRIGGERABLE,BURN-IN (OPTION 21 ONLY)	80009	156-1152-01
U1230	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U1230	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U1240	156-0644-00	B010100	B109999	MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	80009	156-0644-00
U1240	156-0644-03	B110000		MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	04713	MC14066BCLD
U1410	156-0495-00	B010100	B086349	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1410	156-0495-02	B086350		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U1420	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U1420	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U1520	156-0495-00	B010100	B086349	MICROCIRCUIT,LI:OPNL AMPL	27014	LM324N
U1520	156-0495-02	B086350		MICROCIRCUIT,LI:QUAD OPNL AMPL,SELECTED	01295	LM324J/P3
U1530	156-0158-00	B010100	B086349	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458V
U1530	156-0158-03	B086350		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U1560	156-0350-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U1560	156-0350-02	B086350	B109999	MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
U1560	156-0350-05	B110000		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
U1650	150-1039-00 ----- -----	B010100	B085834	LAMP,GLOW,RDOUT:NEON,7 SEGMENT,1.5 DIGIT (STANDARD ONLY)	52536	SP331
U1650	150-1039-01 ----- -----	B085835		LAMP,GLOW,RDOUT:NEON,7 SEGMENT,1.5 DIGIT (STANDARD ONLY)	73138	SP331-02
U1650	150-1039-00 ----- -----	B010100	B085819	LAMP,GLOW,RDOUT:NEON,7 SEGMENT,1.5 DIGIT (OPTION 21 ONLY)	52536	SP331
U1650	150-1039-01 ----- -----	B085820		LAMP,GLOW,RDOUT:NEON,7 SEGMENT,1.5 DIGIT (OPTION 21 ONLY)	73138	SP331-02
U1655	150-1015-00 ----- -----	B010100	B085834	LAMP,GLOW,RDOUT:ORANGE,2.0 DIGIT (STANDARD ONLY)	73138	SP332

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U1655	150-1015-01	B085835		LAMP,GLOW,RDOUT:ORANGE,2.0 DIGIT	73138	SP332-01
	----- -----			(STANDARD ONLY)		
U1655	150-1015-00	B010100	B085819	LAMP,GLOW,RDOUT:ORANGE,2.0 DIGIT	73138	SP332
	----- -----			(OPTION 21 ONLY)		
U1655	150-1015-01	B085820		LAMP,GLOW,RDOUT:ORANGE,2.0 DIGIT	73138	SP332-01
	----- -----			(OPTION 21 ONLY)		
U2302	156-0067-00	B010100	B086349	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U2302	156-0067-12	B086350	B099999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U2302	156-0753-01	B100000		MICROCITUIT,DI:EXPAN 4-W 2-INP AOI GATE	02735	CD4086BFX
U2305	156-0067-00	B010100	B086349	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U2305	156-0067-12	B086350	B099999X	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U2310	156-0200-00	B010100	B086349	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456P1
U2310	156-0200-02	B086350	B099999X	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456U
U2315	156-0200-00	B010100	B086349	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456P1
U2315	156-0200-02	B086350	B099999X	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1456U
U2320	156-0067-00	B010100	B086349	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U2320	156-0067-12	B086350	B099999X	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
U2322	156-1118-00	XB100000		MICROCIRCUIT,LI:ANALOG/DIGITAL CONVERTER	04713	MC14433PD
U2323	156-0800-01	XB100000		MICROCIRCUIT,DI:QUAD LATCH	04713	MC14042BCLD
U2330	156-0751-00	B010100	B099999X	MICROCIRCUIT,LI:ADC SUBSYSTEM	04713	MC1405L
U2333	156-0330-00	XB100000		MICROCIRCUIT,DI:HEX.BUFFER	80009	156-0330-00
U2335	156-0289-00	B010100	B099999	MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	07263	74LS95(PC OR DC)
U2335	156-1368-00	B100000		MICROCIRCUIT,DI:DUAL BIN 1 OF 4 DECOD/DEMULT	04713	MC14555BCL
U2340	156-0749-00	B010100	B099999X	MICROCIRCUIT,DI:3.5 DIGIT A/DLOGIC SS	04713	MC14435
U2343	156-0494-02	XB100000		MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
U2345	156-0752-00	B010100	B099999	MICROCIRCUIT,DI:DUAL BCD UP COUNTER	80009	156-0752-00
U2345	156-0284-03	B100000		MICROCIRCUIT,DI:BCD 7 SEG DCDR/DRVR	27014	DS8880NA+ORJA+
U2350	156-0284-00	B010100	B099999X	MICROCIRCUIT,DI:BCD-7 SEG DECODER/DRIVER	80009	156-0284-00
U2352	307-0508-00	B010100	B099999X	RES NTWK,FXD FI:15,1M OHM,5%,1.125W	01121	316A105
U2354	156-0925-00	XB100000		MICROCIRCUIT,DI:DUAL 2 WIDE 2INP	02735	CD4085BF
U2355	156-0366-00	B010100	B086349	MICROCIRCUIT,DI:DUAL D-TYPE F-F	80009	156-0366-00
U2355	156-0366-02	B086350	B099999X	MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
U2358	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U2358	156-0349-03	B086350	B099999X	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U2360	156-0402-00	B010100	B086349	MICROCIRCUIT,LI:TIMER	27014	SL34829
U2360	156-0402-03	B086350	B099999X	MICROCIRCUIT,LI:TIMER,TESTED	80009	156-0402-03
U2363	156-0752-01	XB100000		MICROCIRCUIT,DI:DUAL BCD UP COUNTER	04713	MC14518BCLD
U2364	156-0579-02	XB100000		MICROCIRCUIT,DI:DUAL 4 BIT BIN COUNTER,SEL	80009	156-0579-02
U2365	156-0366-00	B010100	B086349	MICROCIRCUIT,DI:DUAL D-TYPE F-F	80009	156-0366-00
U2365	156-0366-02	B086350	B099999X	MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
U2366	156-0350-05	XB100000		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,CHK	80009	156-0350-05
U2375	156-0525-00	B010100	B086349	MICROCIRCUIT,DI:DUAL J-K MASTER SLAVE F-F	80009	156-0525-00
U2375	156-0525-03	B086350	B099999X	MICROCIRCUIT,DI:DUAL J-K MASTER SLAVE FF	80009	156-0525-03
U2380	156-0525-00	B010100	B086349	MICROCIRCUIT,DI:DUAL J-K MASTER SLAVE F-F	80009	156-0525-00
U2380	156-0525-03	B086350	B099999X	MICROCIRCUIT,DI:DUAL J-K MASTER SLAVE FF	80009	156-0525-03
U2382	156-0754-00	B010100	B099999X	MICROCIRCUIT,DI:DUAL 4-INPUT NOR GATES	80009	156-0754-00
U2385	156-0754-00	B010100	B099999X	MICROCIRCUIT,DI:DUAL 4-INPUT NOR GATES	80009	156-0754-00
U2387	156-1437-00	XB100000		MICROCIRCUIT,LI:VOLTAGE	04713	MC1404AU5DS
U2390	156-0349-00	B010100	B086349	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U2390	156-0349-03	B086350	B099999X	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL	80009	156-0349-03
U2395	156-0494-00	B010100	B086349	MICROCIRCUIT,DI:HEX INVERTER/BUFFER	80009	156-0494-00
U2395	156-0494-02	B086350	B099999X	MICROCIRCUIT,DI:HEX INV/BUFF,SELECTED	80009	156-0494-02
U2396	156-0158-03	XB100000		MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK	80009	156-0158-03
U2397	307-0509-00	B010100	B099999X	RES NTWK,FXD FI:7,100K OHM,5%	01121	208A104
V840	154-0508-01			ELECTRON TUBE:CRT	S0482	CT 496 BP7

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
VR120	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR122	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR235	152-0175-01			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	80009	152-0175-01
VR238	152-0175-01			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	80009	152-0175-01
VR334	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR452	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
VR462	152-0166-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ11738
VR491	152-0212-00			SEMICOND DEVICE:ZENER,0.5W,9V,5%	81483	69-9062
VR733	152-0461-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N821
VR2302	152-0317-00	B010100	B099999X	SEMICOND DEVICE:ZENER,0.25W,6.2V,5%	80009	152-0317-00

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors = Ohms (Ω).

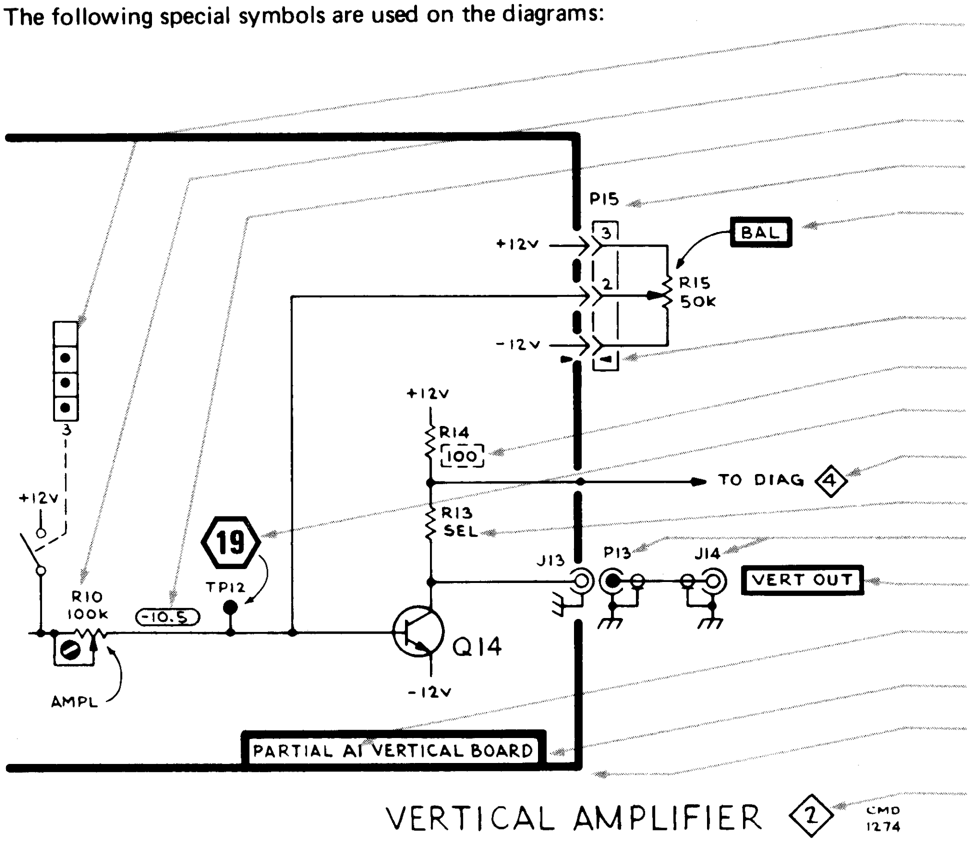
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

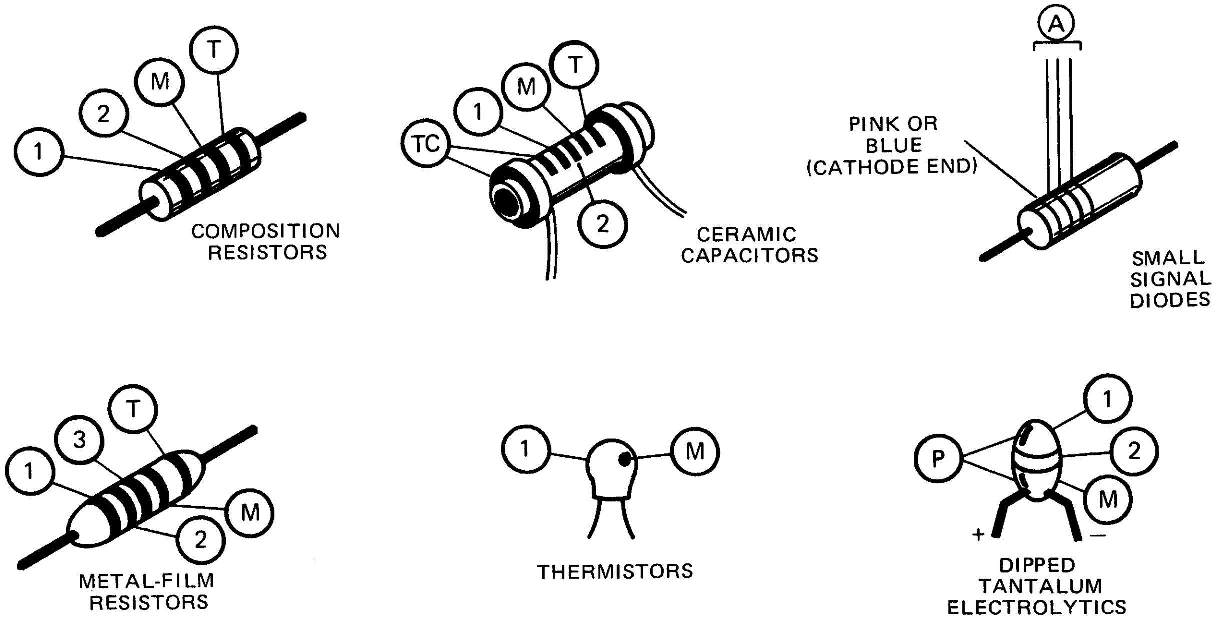
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CB	Circuit breaker
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
E	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
HY	Hybrid circuit
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor or silicon-controlled rectifier
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TC	Thermocouple
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal
Z	Phase shifter

The following special symbols are used on the diagrams:



Cam Switch Closure Chart
Internal Screwdriver Adjustment
Test Voltage
Plug to E.C. Board
Panel Adjustment
Plug Index
Modified Component—See Parts List
Refer to Waveform
Refer to Diagram Number
SEL Value Selected at Factory
Coaxial Connector
Panel Connector
Assembly Number
Board Name
Etched Circuit Board Outlined in Black
Schematic Name and Number



(A) COLORS IDENTIFY SIGNIFICANT DIGITS IN TEKTRONIX PART NUMBER (E.G. BROWN, GRAY, GREEN STRIPES INDICATE PART NUMBER 152-0185-00)

(1) (2) and (3) 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.

(M) MULTIPLIER (T) TOLERANCE;

(TC) TEMPERATURE COEFFICIENT.

(B) TOLERANCE; F=±1%, J=5%, K=10%, M=20%

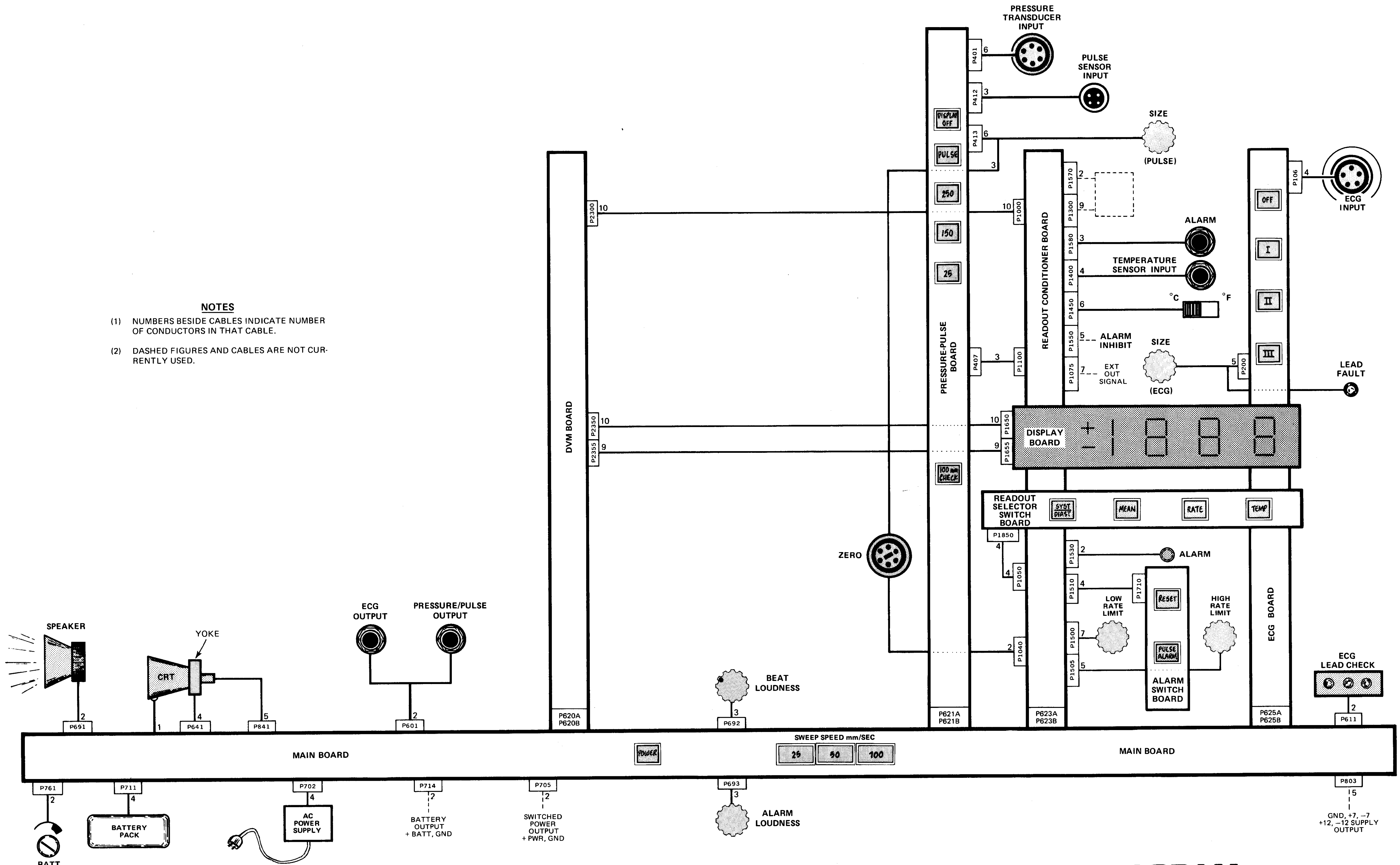
(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;

(P) POLARITY AND VOLTAGE RATING

COLOR	SIGNIFICANT FIGURES	RESISTORS (Ω)		CAPACITORS (pF)			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE		
					Over 10 pF	Under 10 pF	
BLACK	0	1	———	1	±20%	±2 pF	4 VDC
BROWN	1	10	±1%	10	±1%	±0.1 pF	6 VDC
RED	2	10^2 or 100	±2%	10^2 or 100	±2%	———	10 VDC
ORANGE	3	10^3 or 1 K	±3%	10^3 or 1000	±3%	———	15 VDC
YELLOW	4	10^4 or 10 K	±4%	10^4 or 10,000	+100% −9%	———	20 VDC
GREEN	5	10^5 or 100 K	±½%	10^5 or 100,000	±5%	±0.5 pF	25 VDC
BLUE	6	10^6 or 1 M	±¼%	10^6 or 1,000,000	———	———	35 VDC
VIOLET	7	———	±1/10%	———	———	———	50 VDC
GRAY	8	———	———	10^{-2} or 0.01	+80% −20%	±0.25 pF	———
WHITE	9	———	———	10^{-1} or 0.1	±10%	±1 pF	3 VDC
GOLD	–	10^{-1} or 0.1	±5%	———	———	———	———
SILVER	–	10^{-1} or 0.01	±10%	———	———	———	———
NONE	–	———	±20%	———	±10%	±1 pF	———

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Fig. 8-1. Component value identification.



NOTES

(1) NUMBERS BESIDE CABLES INDICATE NUMBER OF CONDUCTORS IN THAT CABLE.

(2) DASHED FIGURES AND CABLES ARE NOT CURRENTLY USED.

414 CABLING DIAGRAM

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414 I.C. TRUTH TABLES

Symbol Definitions

1 High Level	X Don't Care	‾_ Negative Transition	⊓ One High Level Pulse
0 Low Level	_/‾ Positive Transition	CL Clock Level Change	⊔ One Low Level Pulse

IC TRUTH TABLES & SEMICONDUCTORS

4013 (156-0366-00)
DUAL 'D' TYPE FLIP-FLOP
(U1015, U2365, U2355)

CL▲	D	R	S	Q	Q̄	
_/‾	0	0	0	0	1	
_/‾	1	0	0	1	0	
‾_	X	0	0	Q	Q̄	NO CHANGE
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

4016 (156-0289-00)
4066 (156-0644-00)
QUAD BILATERAL SWITCH
(U2335, U472, U624)
(U1240, U1060, U1130)

CONTROL	SWITCH
1	closed
0	open

4027 (156-0525-00)
DUAL J-K MASTER SLAVE FLIP-FLOP
(U2375, U2380)

PRESENT STATE						NEXT STATE		
INPUTS				OUTPUT	CL▲	OUTPUTS		
J	K	S	R	Q		Q	Q̄	
1	X	0	0	0	_/‾	1	0	
X	0	0	0	1	_/‾	1	0	
0	X	0	0	0	_/‾	0	1	
X	1	0	0	1	_/‾	0	1	
X	X	0	0	X	‾_			←NO CHANGE
X	X	1	0	X	X	1	0	
X	X	0	1	X	X	0	1	
X	X	1	1	X	X	1	1	

4028 (156-0756-00)
BCD-to-DECIMAL DECODER
(U1005)

D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0	0	0	0
0	0	1	1	0	0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0	0	0
0	1	0	1	0	0	0	0	0	1	0	0	0	0
0	1	1	0	0	0	0	0	0	0	1	0	0	0
0	1	1	1	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	1	0	0	0	0	0	0	0	0	0	1

4051 (156-0513-00)
MULTIPLEXER/DEMULTIPLEXER
(U1010)

INPUT STATES				"ON" CHANNELS
INHIBIT	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	NONE

74C221 (156-0750-00)
DUAL MONSTABLE MULTIVIBRATOR
(U1210, U1020)

INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
0	X	X	0	1
X	1	X	0	1
X	X	0	0	1
1	0	_/‾	⊓	⊔
1	‾_	1	⊓	⊔

Note: Pins 1 and 9 are 'A' contacts, pins 2 and 10 are 'B' contacts.

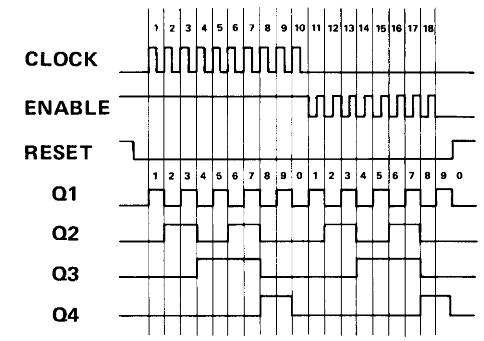
Fig. 8-2. Integrated circuit truth tables.

SEMICONDUCTORS ➧

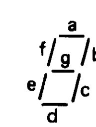
2042-44

4518 (156-0752-00)
DUAL UP COUNTERS
(U2345)

CLOCK	ENABLE	RESET	ACTION
_/‾	1	0	Increment Counter
0	‾_	0	Increment Counter
‾_	X	0	No Change
X	_/‾	0	No Change
_/‾	0	0	No Change
1	‾_	0	No Change
X	X	1	Q1 thru Q4 = 0



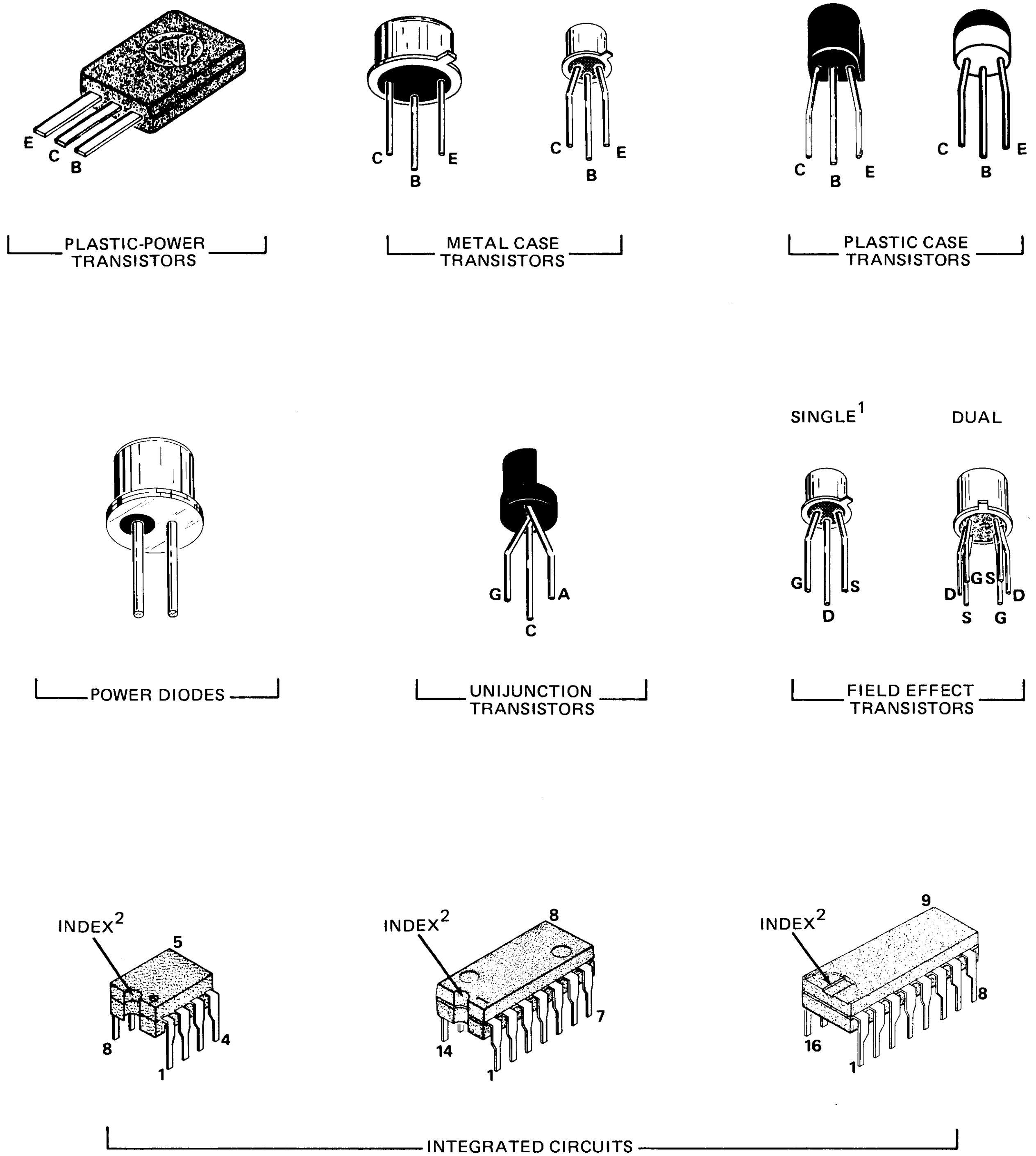
DM8880 (156-0284-00)
DECODER/DRIVER
(U2350)



(SYMBOL IDENTIFICATION)

DECIMAL OR FUNCTION	RB1	D	C	B	A	B1/RB0	a	b	c	d	e	f	g	DISPLAY
0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
1	X	0	0	0	1	1	1	0	0	1	1	1	1	1
2	X	0	0	1	0	1	0	0	1	0	0	1	0	2
3	X	0	0	1	1	1	0	0	0	0	1	1	0	3
4	X	0	1	0	0	1	1	0	0	1	1	0	0	4
5	X	0	1	0	1	1	0	1	0	0	1	0	0	5
6	X	0	1	1	0	1	0	1	0	0	0	0	0	6
7	X	0	1	1	1	1	0	0	0	1	1	1	1	7
8	X	1	0	0	0	1	0	0	0	0	0	0	0	8
9	X	1	0	0	1	1	0	0	0	0	1	0	0	9
10	X	1	0	1	0	1	0	0	0	1	0	0	0	A
11	X	1	0	1	1	1	1	1	0	0	0	0	0	b
12	X	1	1	0	0	1	0	1	1	0	0	0	1	C
13	X	1	1	0	1	1	1	0	0	0	0	1	0	d
14	X	1	1	1	0	1	0	1	1	0	0	0	0	E
15	X	1	1	1	1	1	0	1	1	1	0	0	0	F
B1	X	X	X	X	X	0	1	1	1	1	1	1	1	
RB1	0	0	0	0	0	0	1	1	1	1	1	1	1	

Fig. 8-2. Integrated circuit truth tables (cont.).

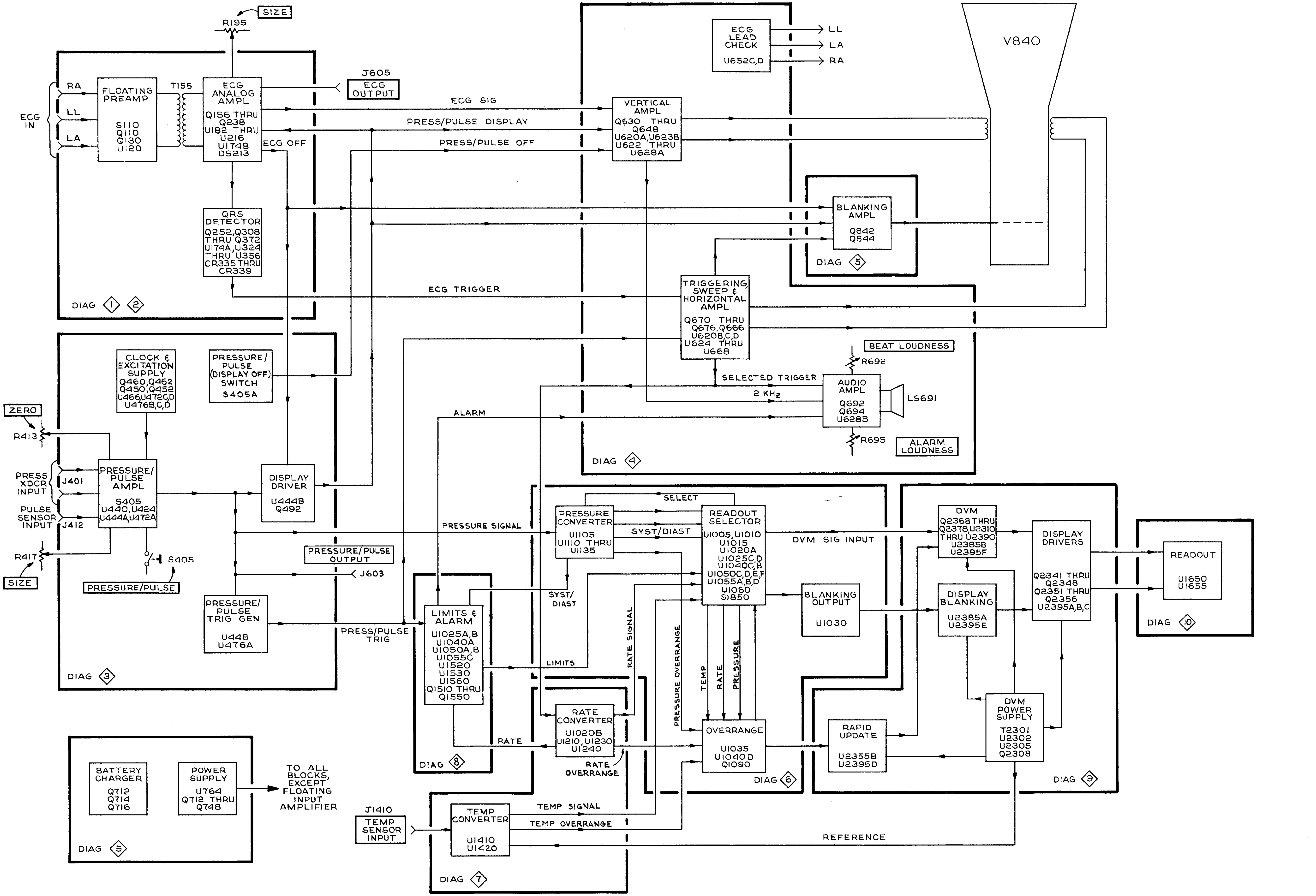


[1] Source and drain may be reversed, see schematic diagram.

[2] INDEX configuration may vary from one IC to the next.

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Fig. 8-3. Semiconductor lead configurations.



BLOCK DIAGRAM

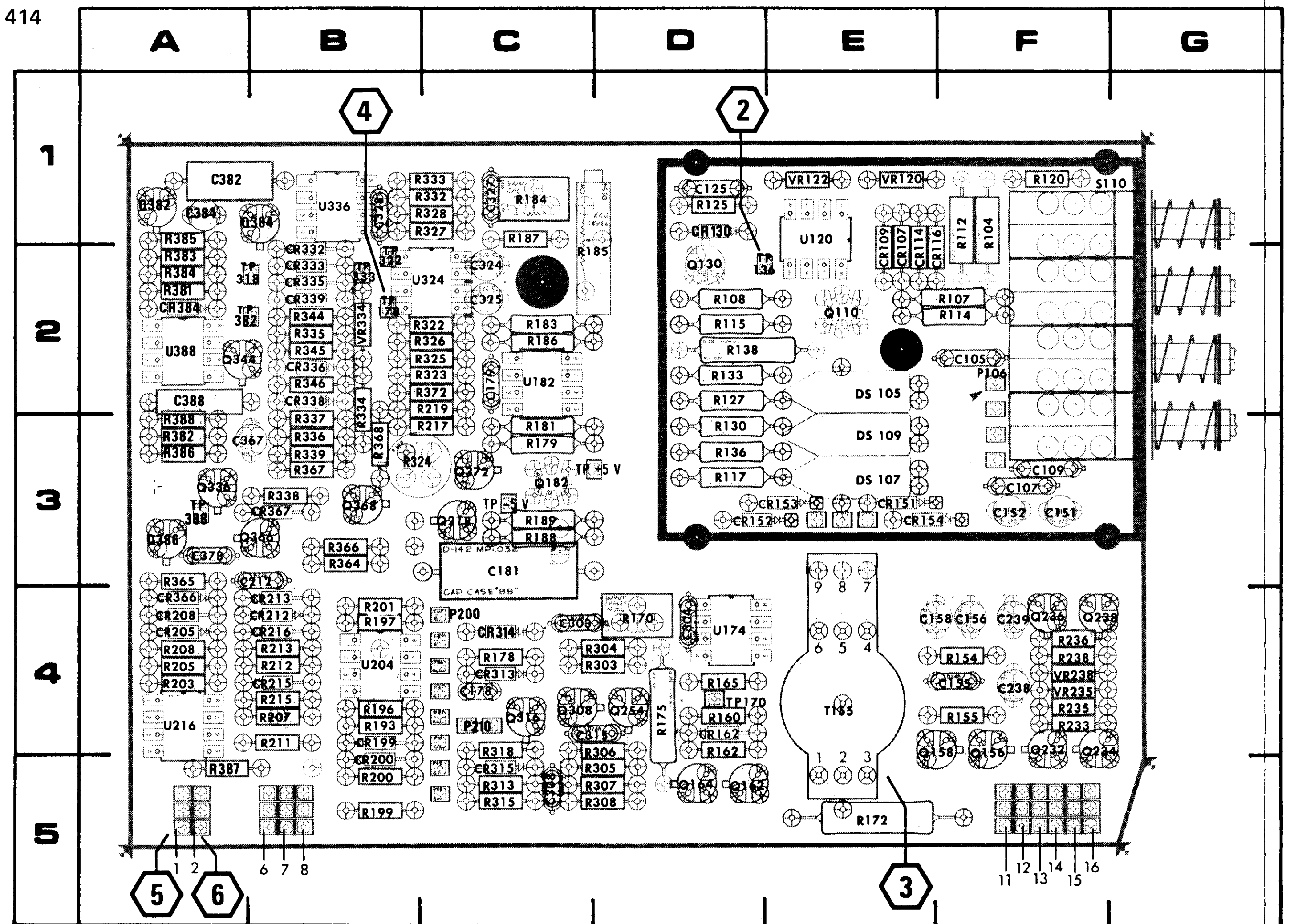
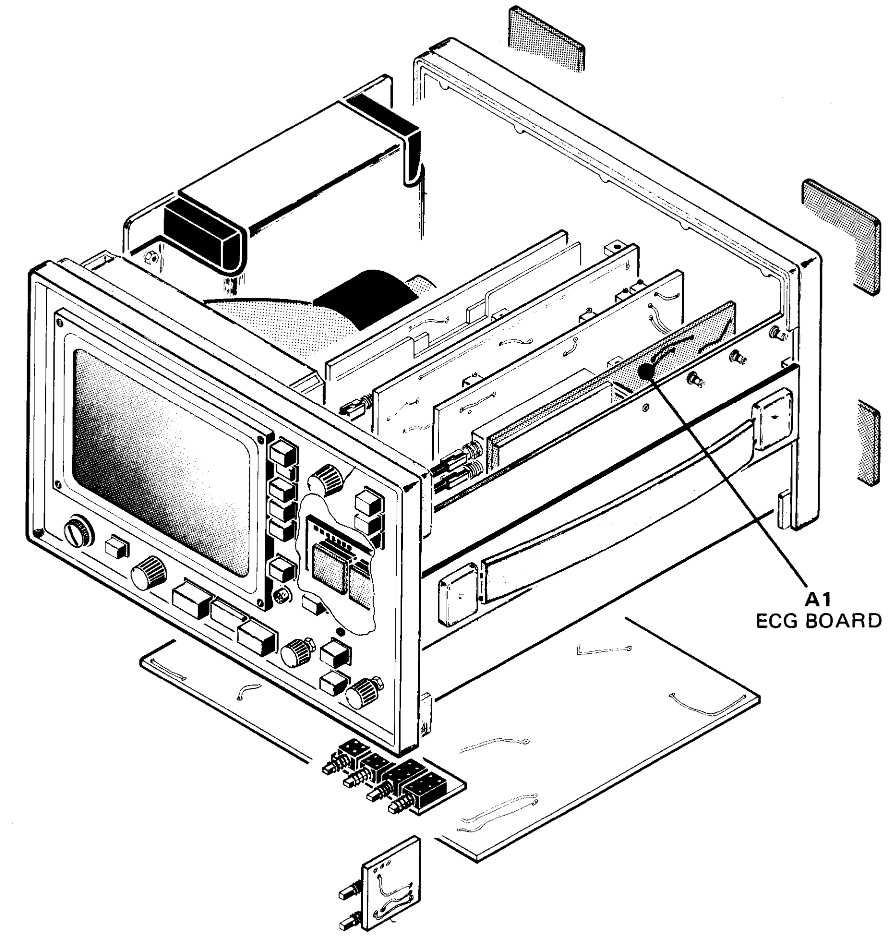


Fig. 8-4. A1—ECG board component locations.



CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C105	2F	C328	1B	CR213	4B	P200	4C	Q372	3C	R162	4D	R205	4A	R322	2C	R368	3B	TP+5V	3D
C107	3F	C367	3A	CR215	4B	P210	4C	Q382	1A	R165	4D	R207	4B	R323	2C	R372	2C	TP−5V	3C
C109	3F	C373	3A	CR216	4B			Q384	1B	R170	4D	R208	4A	R324	3B	R381	2A		
C125	1D	C382	1A	CR313	4C	Q110	2E	Q386	3A	R172	5E	R211	4B	R325	2C	R382	3A	U120	1E
C151	3F	C384	1A	CR314	4C	Q130	2D			R175	4D	R212	4B	R326	2C	R383	2A	U174	4D
C152	3F	C388	2A	CR315	5C	Q156	4F	R104	1F	R178	4C	R213	4B	R327	1C	R384	2A	U182	2C
C155	4F			CR332	2B	Q158	4F	R107	2F	R179	3C	R215	4B	R328	1C	R385	1A	U204	4B
C156	4F	CR107	2E	CR333	2B	Q162	5D	R108	2D	R181	3C	R217	3C	R332	1C	R386	3A	U216	4A
C158	4F	CR109	2E	CR335	2B	Q164	5D	R112	1F	R183	2C	R219	2C	R333	1C	R387	5A	U324	2C
C178	4C	CR114	2E	CR336	2B	Q182	3C	R114	2F	R184	1C	R233	4F	R334	2B	R388	3A	U336	1B
C179	2C	CR116	2F	CR338	2B	Q218	3C	R115	2D	R185	2C	R235	4F	R335	2B			U388	2A
C181	3C	CR130	1D	CR339	2B	Q232	4F	R117	3D	R186	2C	R236	4F	R336	3B	S110	1G		
C212	3B	CR151	3E	CR366	4A	Q234	4F	R120	1F	R187	1C	R238	4F	R337	3B	T155	4E	VR120	1E
C238	4F	CR152	3D	CR367	3B	Q236	4F	R125	1D	R188	3C	R303	4D	R338	3B			VR122	1E
C239	4F	CR153	3E	CR384	2A	Q238	4F	R127	2D	R189	3C	R304	4D	R339	3B	TP136	2D	VR235	4F
C303	4C	CR154	3E			Q254	4D	R130	3D	R193	4B	R305	5D	R344	2B	TP170	4D	VR238	4F
C304	4D	CR162	4D			Q308	4C	R133	2D	R196	4B	R306	4D	R345	2B	TP178	2B	VR334	2B
C308	5C	CR199	4B	DS105	2E	Q316	4C	R136	3D	R197	4B	R307	5D	R346	2B	TP318	2A		
C315	4C	CR200	5B	DS107	3E	Q336	3A	R138	2D	R199	5B	R308	5D	R364	3B	TP322	2B		
C324	2C	CR205	4A	DS109	3E	Q344	2A	R154	4F	R200	5B	R313	5C	R365	3A	TP333	2B		
C325	2C	CR208	4A			Q366	3B	R155	4F	R201	4B	R315	5C	R366	3B	TP382	2A		
C327	1C	CR212	4B	P106	2F	Q368	3B	R160	4D	R203	4A	R318	4C	R367	3B	TP388	3A		

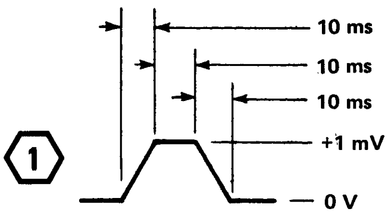
ECG CHANNEL VOLTAGE AND WAVEFORM CONDITIONS

Voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

Waveforms are idealized and may vary from actual test-oscilloscope waveforms.

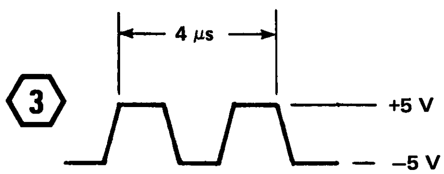
414 SETTINGS AND INPUTS

ECG	Lead II
SIZE	Mid-range (20 mm/mV)
ECG INPUT	(a) 1 mV, 150 bpm ECG Test Pulse applied between LL (pin E) and RA (pin A). (b) Pin A shorted to pin B. (c) For Pacer test, substitute Pacer Test Pulse for ECG Test Pulse.



ECG TEST PULSE
AT 150 BPM RATE

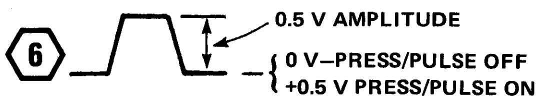


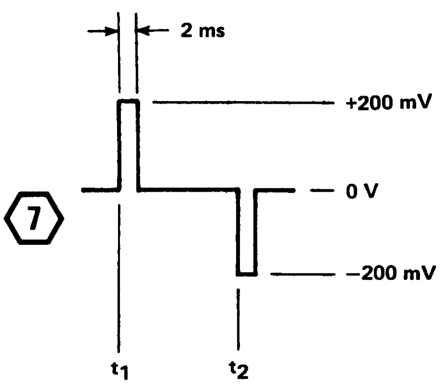


f = 250 kHz

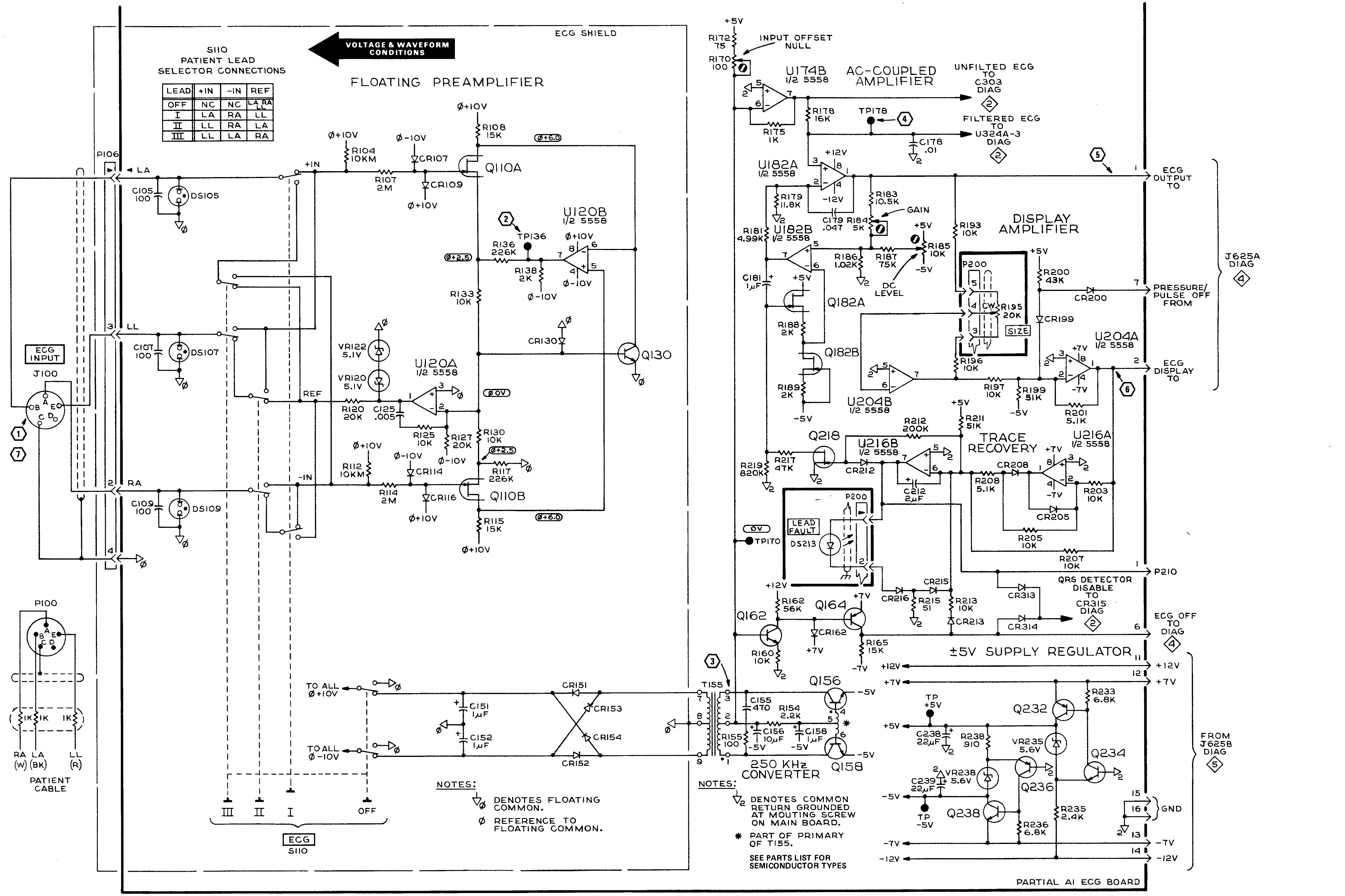








PACER TEST SIGNAL
150 BPM RATE



REV A, AUG 1978
2042-81

ECG 1

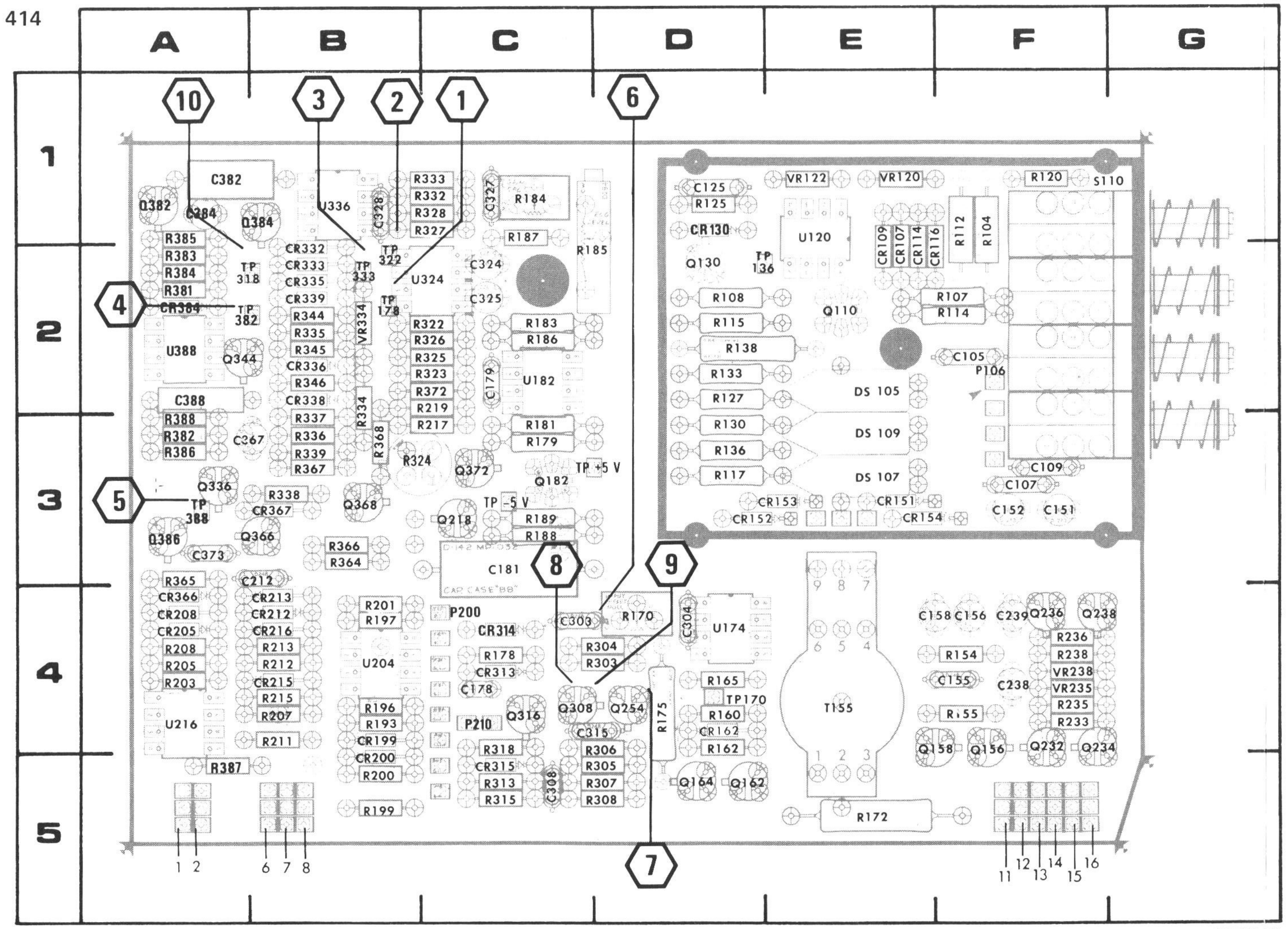
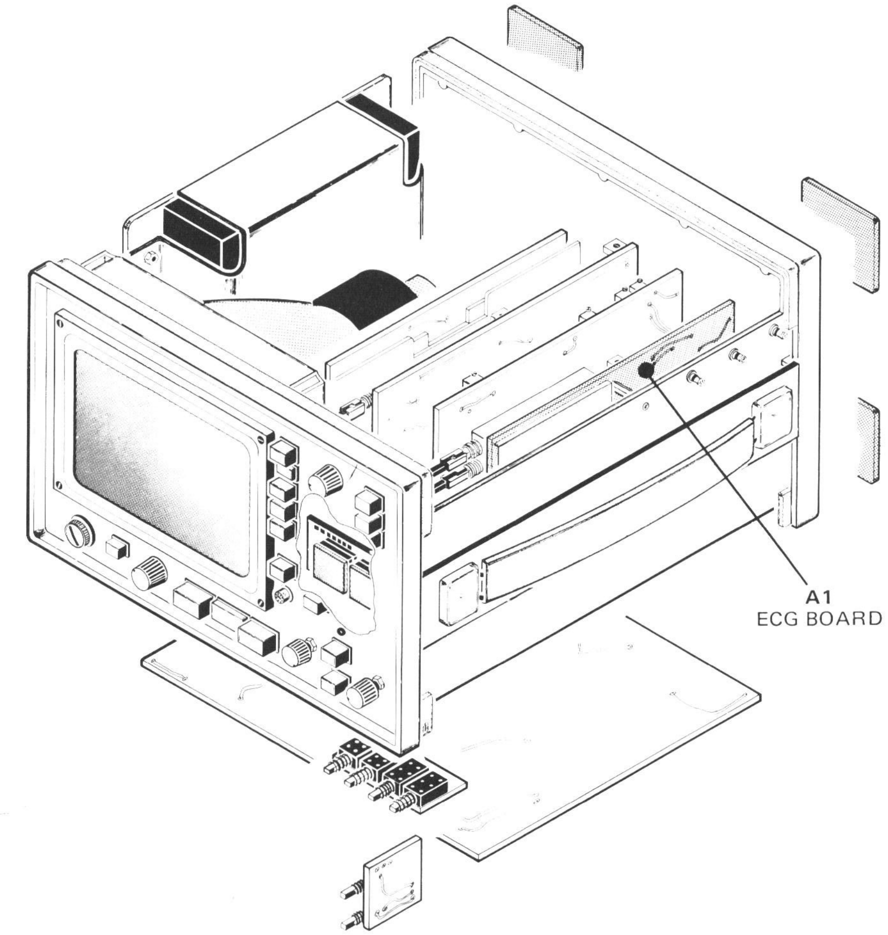


Fig. 8-5. A1—ECG board component locations.



CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C105	2F	C328	1B	CR213	4B	P200	4C	Q372	3C	R162	4D	R205	4A	R322	2C	R368	3B	TP+5V	3D
C107	3F	C367	3A	CR215	4B	P210	4C	Q382	1A	R165	4D	R207	4B	R323	2C	R372	2C	TP–5V	3C
C109	3F	C373	3A	CR216	4B			Q384	1B	R170	4D	R208	4A	R324	3B	R381	2A		
C125	1D	C382	1A	CR313	4C	Q110	2E	Q386	3A	R172	5E	R211	4B	R325	2C	R382	3A	U120	1E
C151	3F	C384	1A	CR314	4C	Q130	2D			R175	4D	R212	4B	R326	2C	R383	2A	U174	4D
C152	3F	C388	2A	CR315	5C	Q156	4F	R104	1F	R178	4C	R213	4B	R327	1C	R384	2A	U182	2C
C155	4F			CR332	2B	Q158	4F	R107	2F	R179	3C	R215	4B	R328	1C	R385	1A	U204	4B
C156	4F	CR107	2E	CR333	2B	Q162	5D	R108	2D	R181	3C	R217	3C	R332	1C	R386	3A	U216	4A
C158	4F	CR109	2E	CR335	2B	Q164	5D	R112	1F	R183	2C	R219	2C	R333	1C	R387	5A	U324	2C
C178	4C	CR114	2E	CR336	2B	Q182	3C	R114	2F	R184	1C	R233	4F	R334	2B	R388	3A	U336	1B
C179	2C	CR116	2F	CR338	2B	Q218	3C	R115	2D	R185	2C	R235	4F	R335	2B			U388	2A
C181	3C	CR130	1D	CR339	2B	Q232	4F	R117	3D	R186	2C	R236	4F	R336	3B	S110	1G		
C212	3B	CR151	3E	CR366	4A	Q234	4F	R120	1F	R187	1C	R238	4F	R337	3B	T155	4E	VR120	1E
C238	4F	CR152	3D	CR367	3B	Q236	4F	R125	1D	R188	3C	R303	4D	R338	3B			VR122	1E
C239	4F	CR153	3E	CR384	2A	Q238	4F	R127	2D	R189	3C	R304	4D	R339	3B	TP136	2D	VR235	4F
C303	4C	CR154	3E			Q254	4D	R130	3D	R193	4B	R305	5D	R344	2B	TP170	4D	VR238	4F
C304	4D	CR162	4D			Q308	4C	R133	2D	R196	4B	R306	4D	R345	2B	TP178	2B	VR334	2B
C308	5C	CR199	4B	DS105	2E	Q316	4C	R136	3D	R197	4B	R307	5D	R346	2B	TP318	2A		
C315	4C	CR200	5B	DS107	3E	Q336	3A	R138	2D	R199	5B	R308	5D	R364	3B	TP322	2B		
C324	2C	CR205	4A	DS109	3E	Q344	2A	R154	4F	R200	5B	R313	5C	R365	3A	TP333	2B		
C325	2C	CR208	4A			Q366	3B	R155	4F	R201	4B	R315	5C	R366	3B	TP382	2A		
C327	1C	CR212	4B	P106	2F	Q368	3B	R160	4D	R203	4A	R318	4C	R367	3B	TP388	3A		

ECG CHANNEL VOLTAGE AND WAVEFORM CONDITIONS

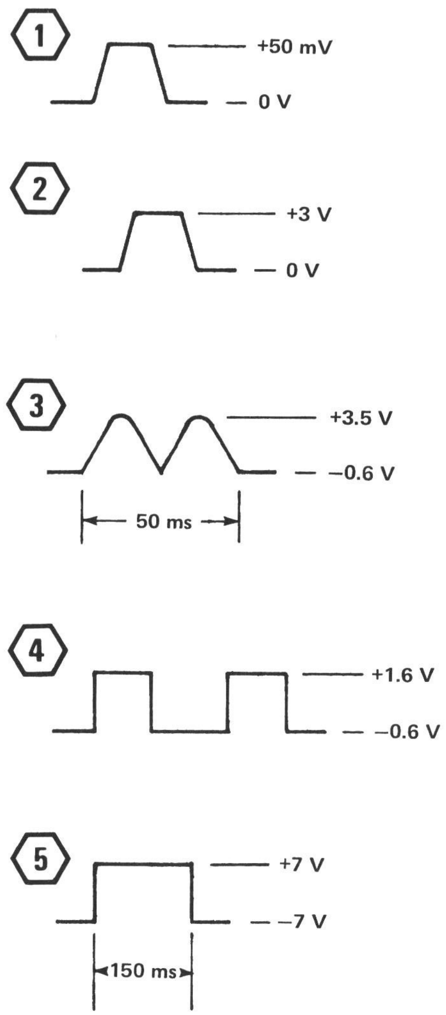
Voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

Waveforms are idealized and may vary from actual test-oscilloscope waveforms.

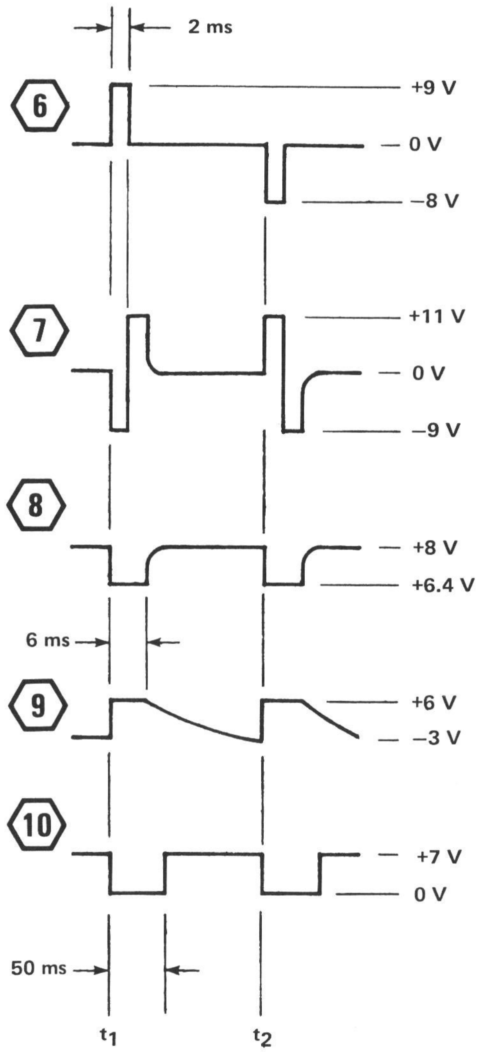
414 SETTINGS AND INPUTS

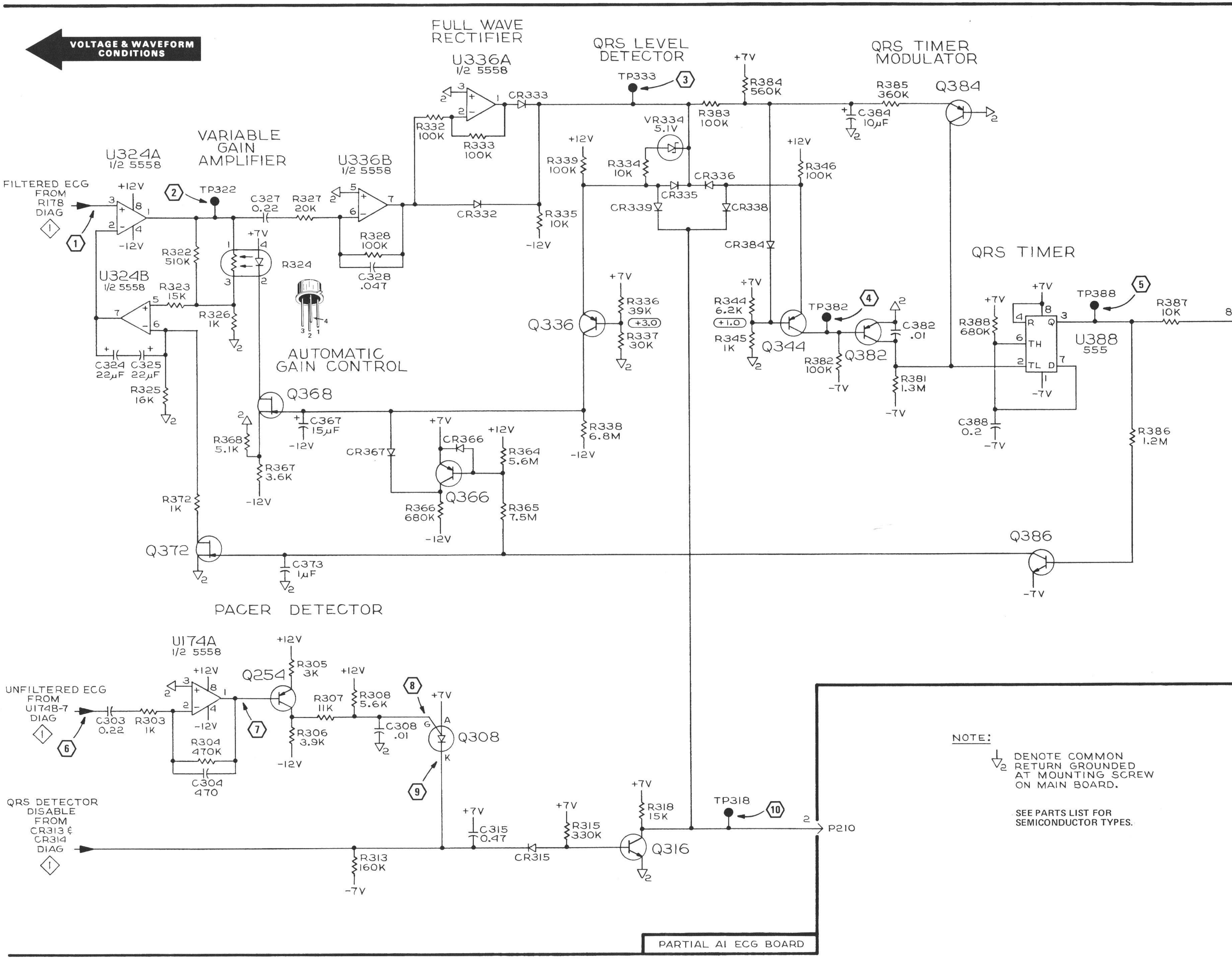
ECG	Lead II
SIZE	Mid-range (20 mm/mV)
ECG INPUT	(a) 1 mV, 150 bpm ECG Test Pulse applied between LL (pin E) and RA (pin A). (b) Pin A shorted to pin B. (c) For Pacer test, substitute Pacer Test Pulse for ECG Test Pulse.

<u>ECG TEST PULSE WAVEFORMS</u>:



<u>PACER TEST PULSE WAVEFORMS</u>:




VOLTAGE & WAVEFORM CONDITIONS
FILTERED ECG FROM R178 DIAG ①
U324A 1/2 5558
U324B 1/2 5558
VARIABLE GAIN AMPLIFIER
TP322
C327 0.22
R327 20K
U336B 1/2 5558
R328 100K
C328 .047
R322 510K
R323 15K
R326 1K
R324
AUTOMATIC GAIN CONTROL
C324 22µF
C325 22µF
R325 16K
FULL WAVE RECTIFIER
U336A 1/2 5558
CR333
R332 100K
R333 100K
CR332
R335 10K
QRS LEVEL DETECTOR
TP333
VR334 5.1V
R334 10K
R339 100K
CR335
CR336
CR339
CR338
CR384
R383 100K
R384 560K
R346 100K
QRS TIMER MODULATOR
R385 360K
C384 10µF
Q384
Q336
R336 39K
+3.0
R337 30K
R338 6.8M
R344 6.2K
+1.0
R345 1K
Q344
TP382
Q382
R382 100K
C382 .01
R381 1.3M
QRS TIMER
R388 680K
C388 0.2
U388 555
TP388
R387 10K
R386 1.2M
ECG TRIGGER TO J625A DIAG ④
Q368
C367 15µF
R368 5.1K
R367 3.6K
CR367
CR366
Q366
R364 5.6M
R365 7.5M
R366 680K
R372 1K
Q372
C373 1µF
Q386
PACER DETECTOR
UNFILTERED ECG FROM U174B-7 DIAG ①
U174A 1/2 5558
C303 0.22
R303 1K
R304 470K
C304 470
Q254
R305 3K
R306 3.9K
R307 11K
R308 5.6K
C308 .01
Q308
QRS DETECTOR DISABLE FROM CR313 & CR314 DIAG ①
R313 160K
C315 0.47
CR315
R315 330K
R318 15K
Q316
TP318
P210
NOTE:
DENOTE COMMON RETURN GROUNDED AT MOUNTING SCREW ON MAIN BOARD.
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A1 ECG BOARD

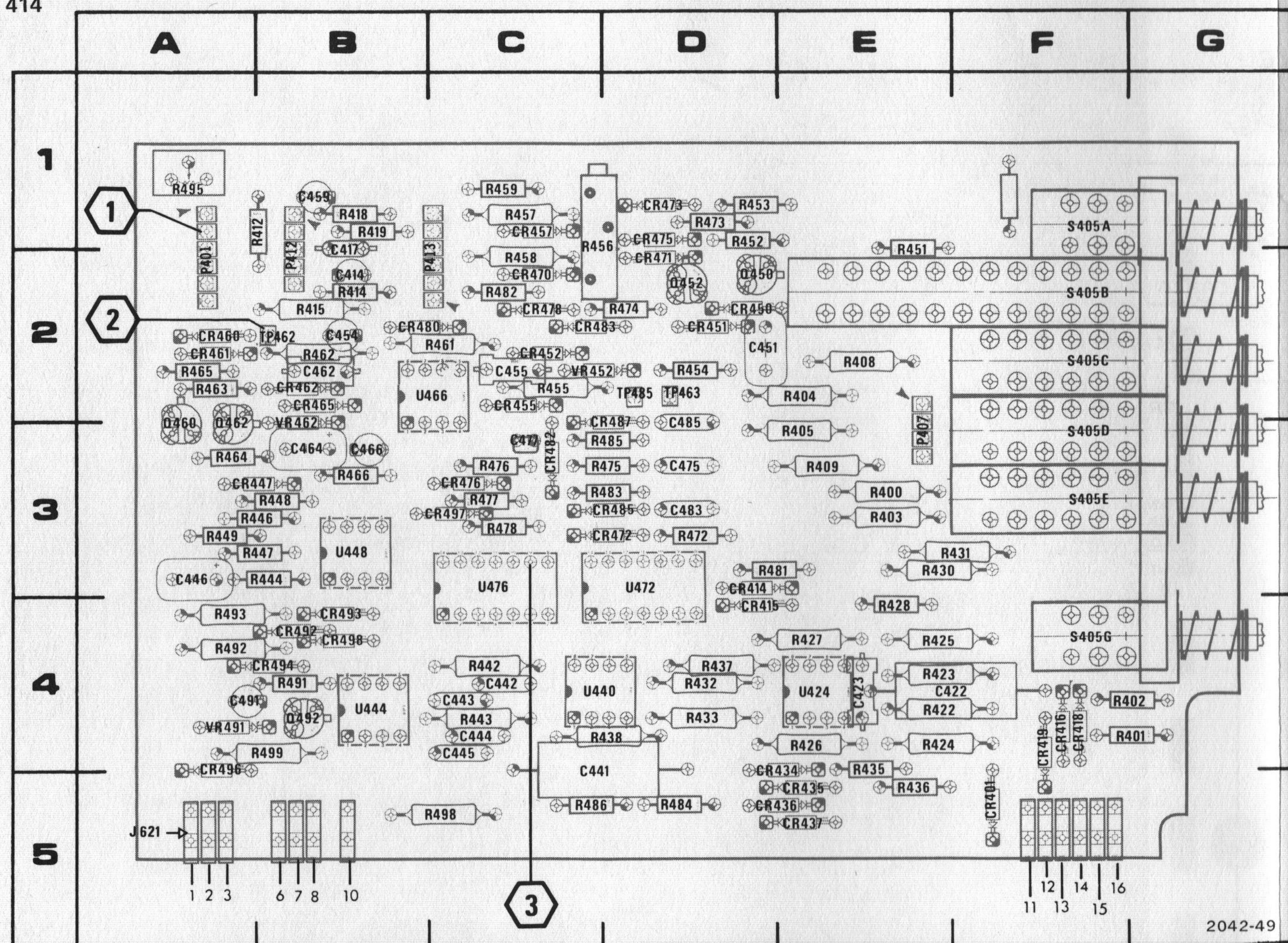
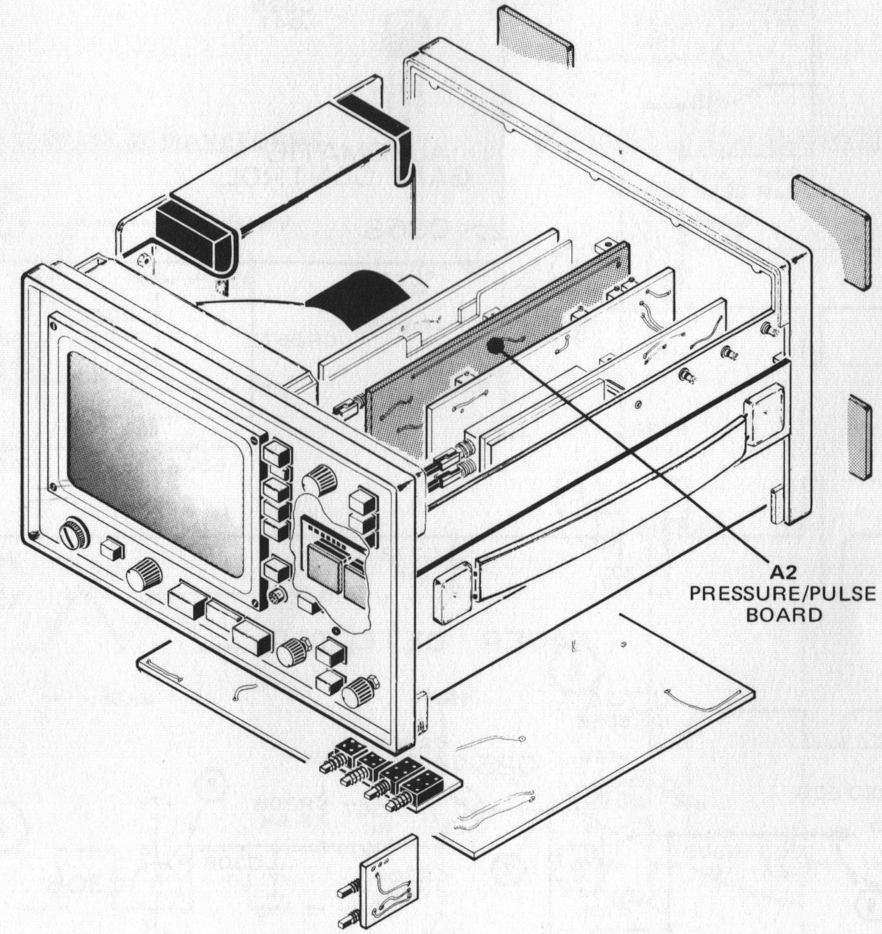


Fig. 8-6. A2—Pressure/Pulse board component locations.

MORE

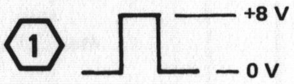
CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C414	2B	CR414	3D	CR476	3C	Q462	3A	R431	3F	R462	2B	S405A	1F
C417	2B	CR415	4D	CR478	2C	Q492	4B	R432	4D	R463	2A	S405B	2F
C422	4E	CR416	4F	CR480	2B			R433	4D	R464	3A	S405C	2F
C423	4E	CR418	4F	CR482	3C	R400	3E	R435	5E	R465	2A	S405D	3F
C441	5C	CR419	4F	CR483	2C	R401	4G	R436	5E	R466	3B	S405E	3F
C442	4C	CR434	5E	CR485	3D	R402	4G	R437	4D	R472	3D	S405G	4F
C443	4C	CR435	5E	CR487	3D	R403	3E	R438	4D	R473	1D		
C444	4C	CR436	5E	CR492	4B	R404	2E	R442	4C	R474	2D	TP462	2B
C445	4C	CR437	5E	CR493	4B	R405	3E	R443	4C	R475	3D	TP463	2D
C446	3A	CR447	3A	CR494	4B	R408	2E	R444	3B	R476	3C	TP4085	2D
C451	2D	CR450	2D	CR496	4A	R409	3E	R446	3B	R477	3C		
C454	2B	CR451	2D	CR497	3C	R412	1B	R447	3B	R478	3C	U424	4E
C455	2C	CR452	2C	CR498	4B	R414	2B	R448	3B	R481	3D	U440	4C
C459	1B	CR455	2C			R415	2B	R449	3A	R482	2C	U444	4B
C462	2B	CR457	1C	J621	5A	R418	1B	R451	2E	R483	3D	U448	3B
C464	3B	CR460	2A			R419	1B	R452	1D	R484	5D	U466	2C
C466	3B	CR461	2A	P401	2A	R422	4E	R453	1D	R485	3D	U472	3D
C475	3D	CR462	2B	P407	3E	R423	4E	R454	2D	R486	5C	U476	3C
C477	3C	CR465	2B	P412	2B	R424	4E	R455	2C	R491	4B		
C483	3D	CR470	2C	P413	2B	R425	4E	R456	1C	R492	4A	VR452	2C
C485	3D	CR471	2D			R426	4E	R457	1C	R493	4A	VR462	3B
C491	4A	CR472	3D	Q450	2D	R427	4E	R458	2C	R495	1A	VR491	4A
		CR473	1D	Q452	2D	R428	4E	R459	1C	R498	5C		
CR401	5F	CR475	1D	Q460	3A	R430	3E	R461	2C	R499	4B		

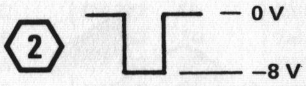


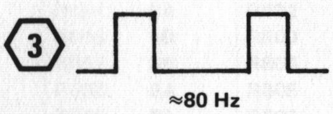
VOLTAGE AND WAVEFORM CONDITIONS
(PRESSURE MODE)

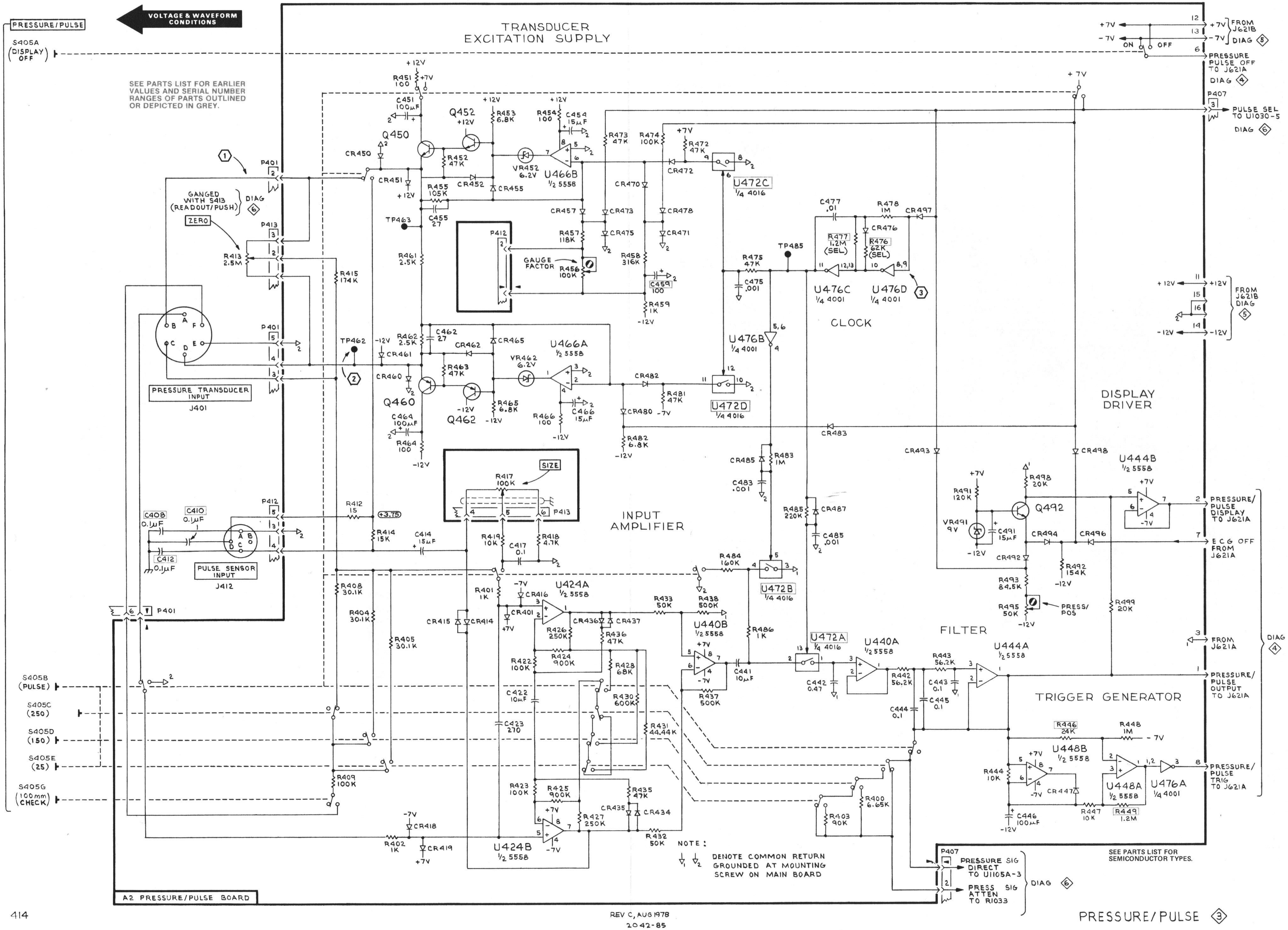
Voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

Waveforms are idealized and may vary from actual test-oscilloscope waveforms.

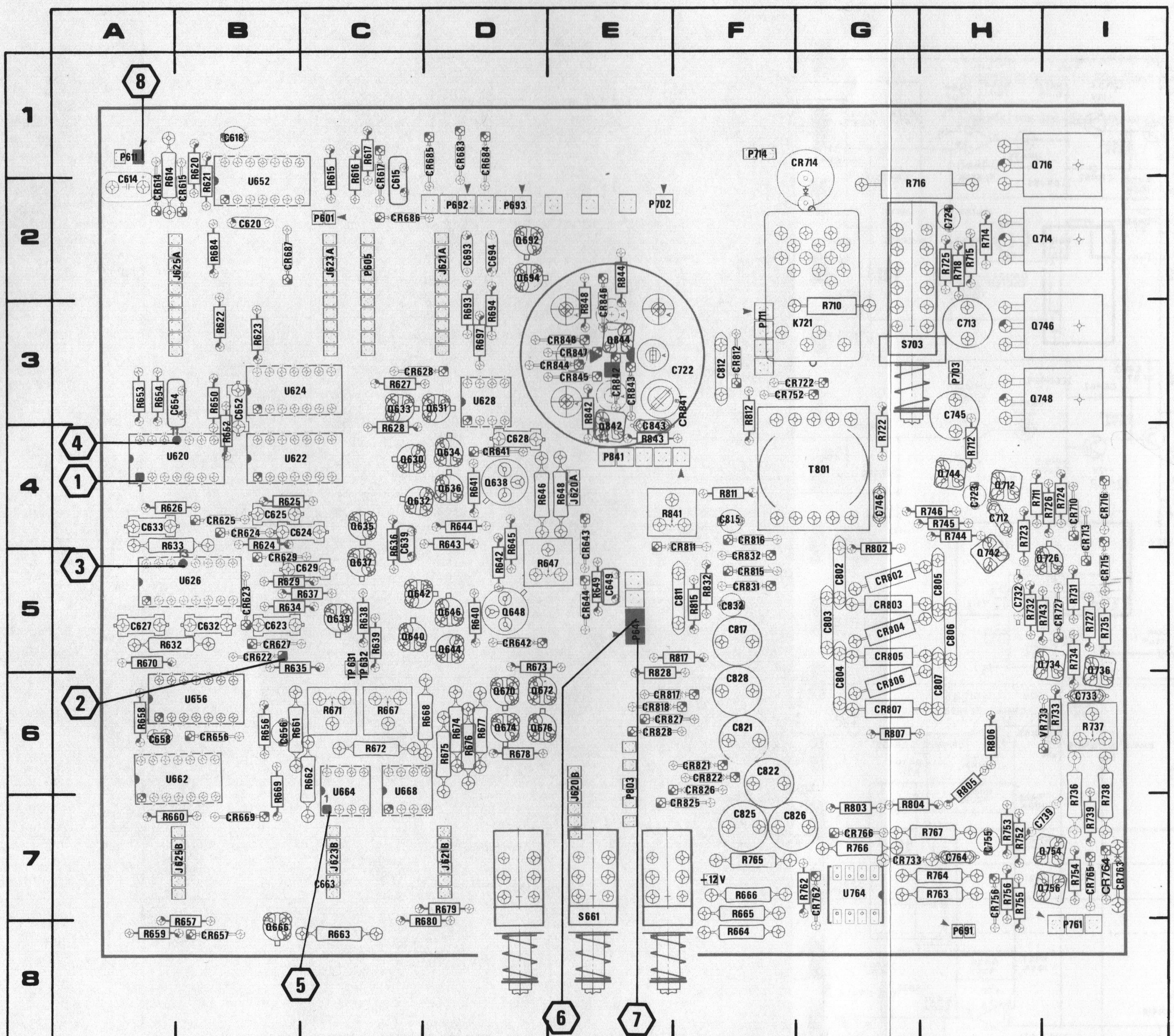








PRESSURE/PULSE ③

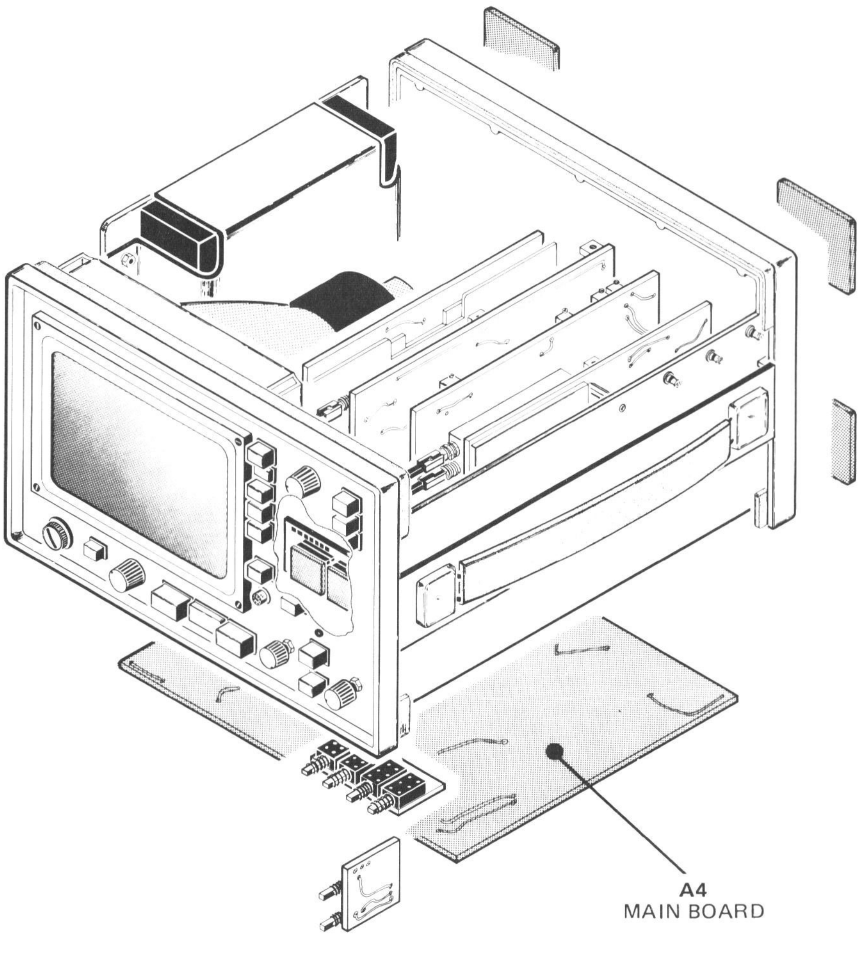


2042-50

Fig. 8-7. A4—Main board component locations.

MORE

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C614	2A	CR669	7B	P703	3H	R641	4D	R746	4H
C615	2C	CR683	1D	P711	3F	R642	5D	R752	7H
C618	1B	CR684	1D	P714	1F	R643	4D	R753	7H
C620	2B	CR685	1D	P761	8I	R644	4D	R754	7I
C623	5B	CR686	2C	P803	6E	R645	4D	R755	7H
C624	4B	CR687	2B	P841	4E	R646	4D	R756	7H
C625	4B	CR710	4I			R647	5E	R762	7G
C627	5A	CR713	4I	Q630	4C	R648	4E	R763	7H
C628	4D	CR714	1G	Q631	3D	R649	5E	R764	7H
C629	5C	CR715	5I	Q632	4C	R650	3B	R765	7F
C632	5B	CR716	4I	Q633	3C	R652	4B	R766	7G
C633	4A	CR722	3G	Q634	4D	R653	3A	R767	7H
C639	4C	CR727	5I	Q635	4C	R654	3A	R802	5G
C649	5E	CR733	7G	Q636	4D	R656	6B	R803	7G
C652	3B	CR752	3F	Q637	5C	R657	8B	R804	7G
C654	3A	CR756	7H	Q638	4D	R658	6A	R805	6H
C656	6B	CR762	7G	Q639	5C	R659	8A	R806	6H
C658	6A	CR763	7I	Q640	5C	R660	7A	R807	6G
C663	7C	CR764	7I	Q642	5C	R661	6B	R811	4F
C693	2D	CR765	7I	Q644	5D	R662	6C	R812	3F
C694	2D	CR766	7G	Q646	5D	R663	8C	R815	5F
C712	4H	CR802	5G	Q648	5D	R664	8F	R817	5F
C713	3H	CR803	5G	Q666	8B	R665	7F	R828	6E
C722	3F	CR804	5G	Q670	6D	R666	7F	R832	5F
C723	4H	CR805	5G	Q672	6D	R667	6C	R841	4E
C724	2H	CR806	6G	Q674	6D	R668	6D	R842	3E
C732	5H	CR807	6G	Q676	6D	R669	6B	R843	4E
C733	6I	CR811	4F	Q692	2D	R670	5A	R844	2E
C739	7I	CR812	3F	Q694	2D	R671	6C	R848	3E
C745	3H	CR815	5F	Q712	4H	R672	6C		
C746	4G	CR816	4F	Q714	2I	R673	5D	S661	7E
C755	7H	CR817	6E	Q716	1I	R674	6D	S703	3G
C764	7H	CR818	6E	Q726	5I	R675	6D		
C802	5G	CR821	6F	Q734	5I	R676	6D	T801	4G
C803	5G	CR822	6F	Q736	6I	R677	6D		
C804	6G	CR825	7F	Q742	5H	R678	6D	TP–12V	7F
C805	5H	CR826	6F	Q744	4H	R679	7D	TP631	5C
C806	5H	CR827	6E	Q746	3I	R680	8D	TP632	5C
C807	6H	CR828	6E	Q748	3I	R684	2B		
C811	5F	CR831	5F	Q754	7I	R693	3D	U620	4B
C812	3F	CR832	5F	Q756	7I	R694	3D	U622	4B
C815	4F	CR841	3F	Q842	4E	R697	3E	U624	3B
C817	5F	CR842	3E	Q844	3E	R710	3G	U626	5B
C821	6F	CR843	3E			R711	4H	U628	3D
C822	6F	CR844	3E	R614	1A	R712	4H	U652	2B
C825	7F	CR845	3E	R615	1C	R714	2H	U656	6B
C826	7G	CR846	3E	R616	1C	R715	2H	U662	6B
C828	6F	CR847	3E	R617	1C	R716	2G	U664	6C
C832	5F	CR848	3E	R620	1B	R718	2H	U668	6C
C843	4E	J620A	4E	R621	2B	R722	4G	U764	7B
		J620B	6E	R622	3B	R723	4H		
CR614	2A	J621A	2D	R623	3B	R724	4I	VR733	6I
CR615	2B	J621B	7D	R624	4B	R725	2H		
CR617	1C	J623A	2C	R625	4B	R726	4I		
CR622	5B	J623B	7C	R626	4A	R727	5I		
CR623	5B	J625A	2B	R627	3C	R731	5I		
CR624	4B	J625B	7B	R628	4C	R732	5H		
CR625	4B			R629	5B	R733	6I		
CR627	5B	K721	3G	R632	5A	R734	5I		
CR628	3C	P601	2C	R633	4A	R735	5I		
CR629	5B	P605	2C	R634	5B	R736	7I		
CR641	4D	P611	1A	R635	5B	R737	6I		
CR642	5D	P641	5E	R636	4C	R738	7I		
CR643	4E	P691	8H	R637	5C	R739	7I		
CR644	5E	P692	2D	R638	5C	R743	5I		
CR656	6B	P693	2D	R639	5C	R744	4H		
CR657	8B	P702	2E	R640	5D	R745	4H		

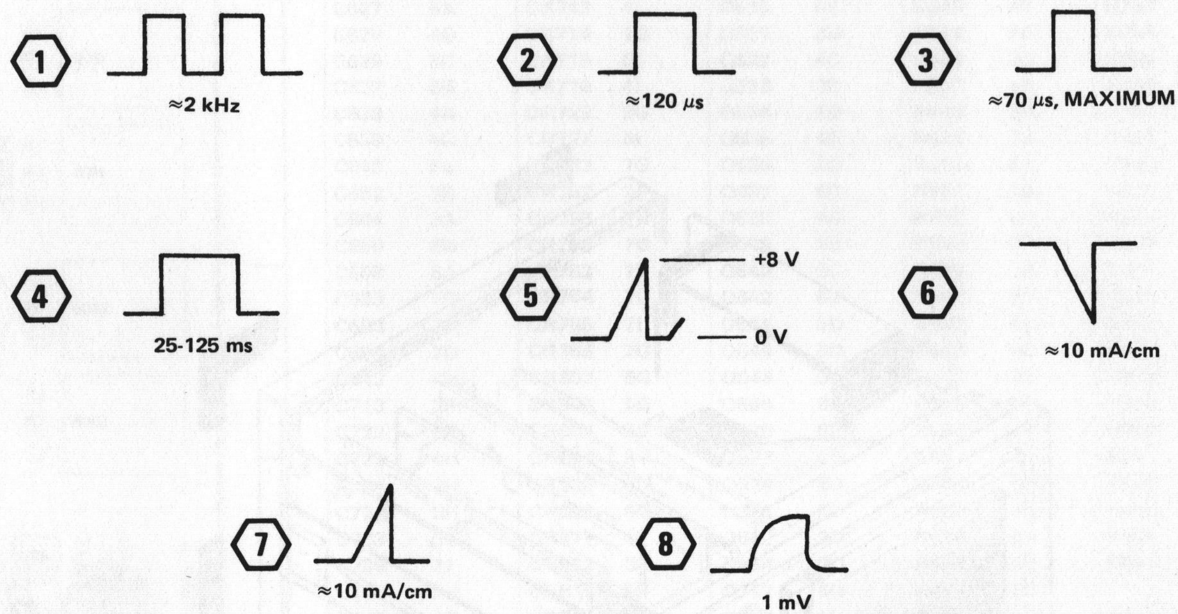

A4
MAIN BOARD

CURRENT, VOLTAGE, AND WAVEFORM CONDITIONS

Currents are voltages are design-center values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

Waveforms are idealized and may vary from actual test-oscilloscope waveforms.

See Theory of Operation section for truth table.



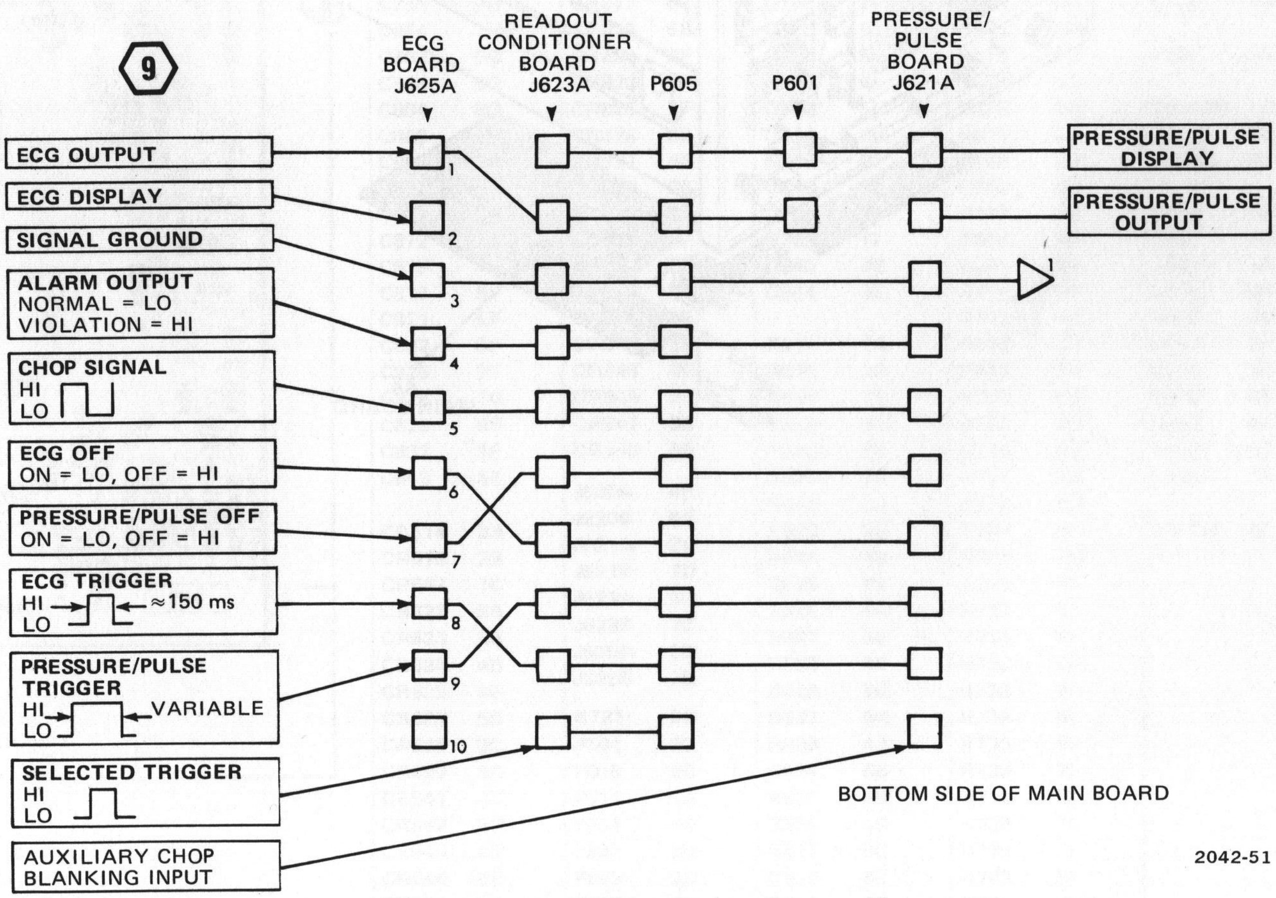
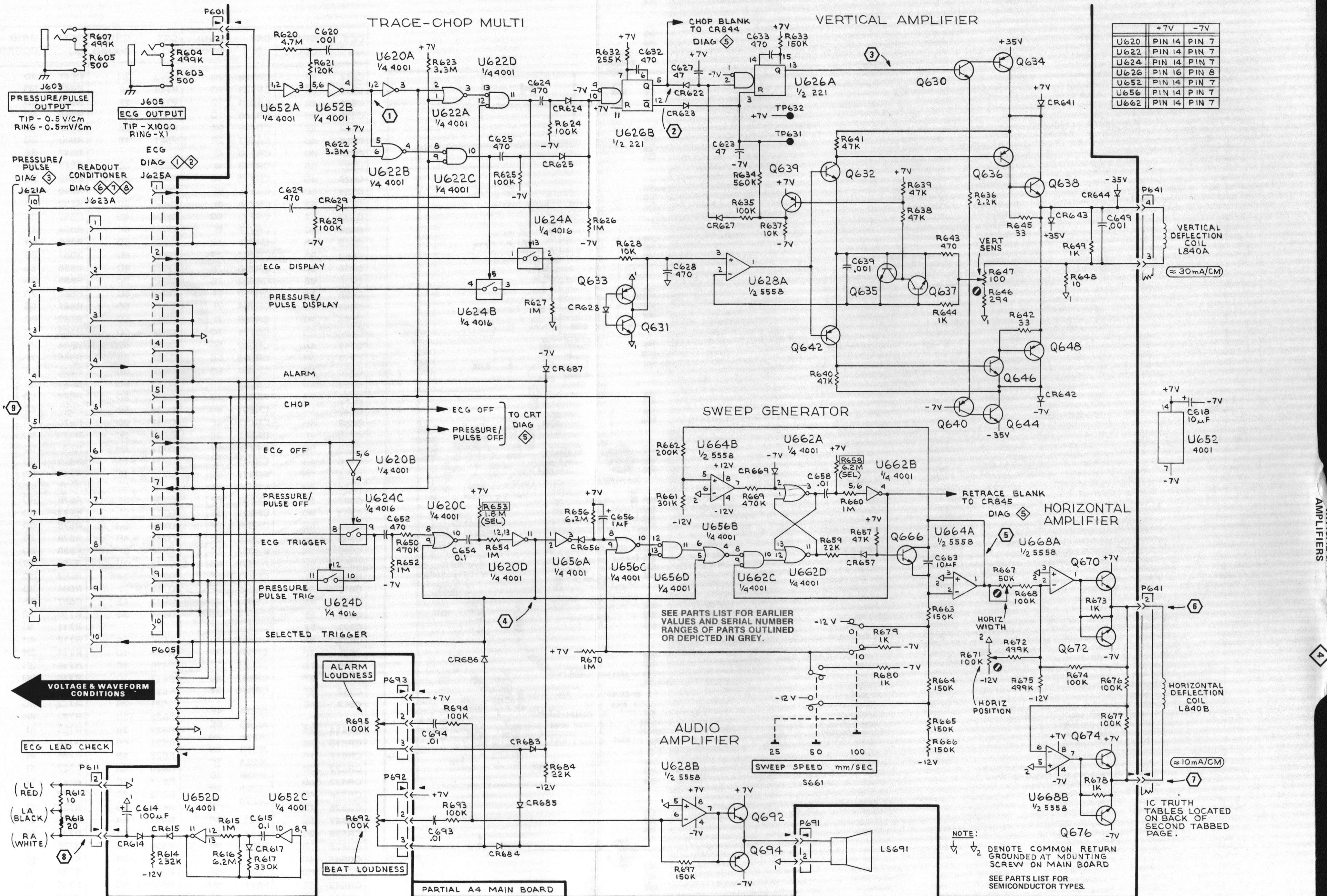


Fig. 8-8. Signals at J621A, J623A, and J625A.



VERTICAL & HORIZONTAL AMPLIFIER 4

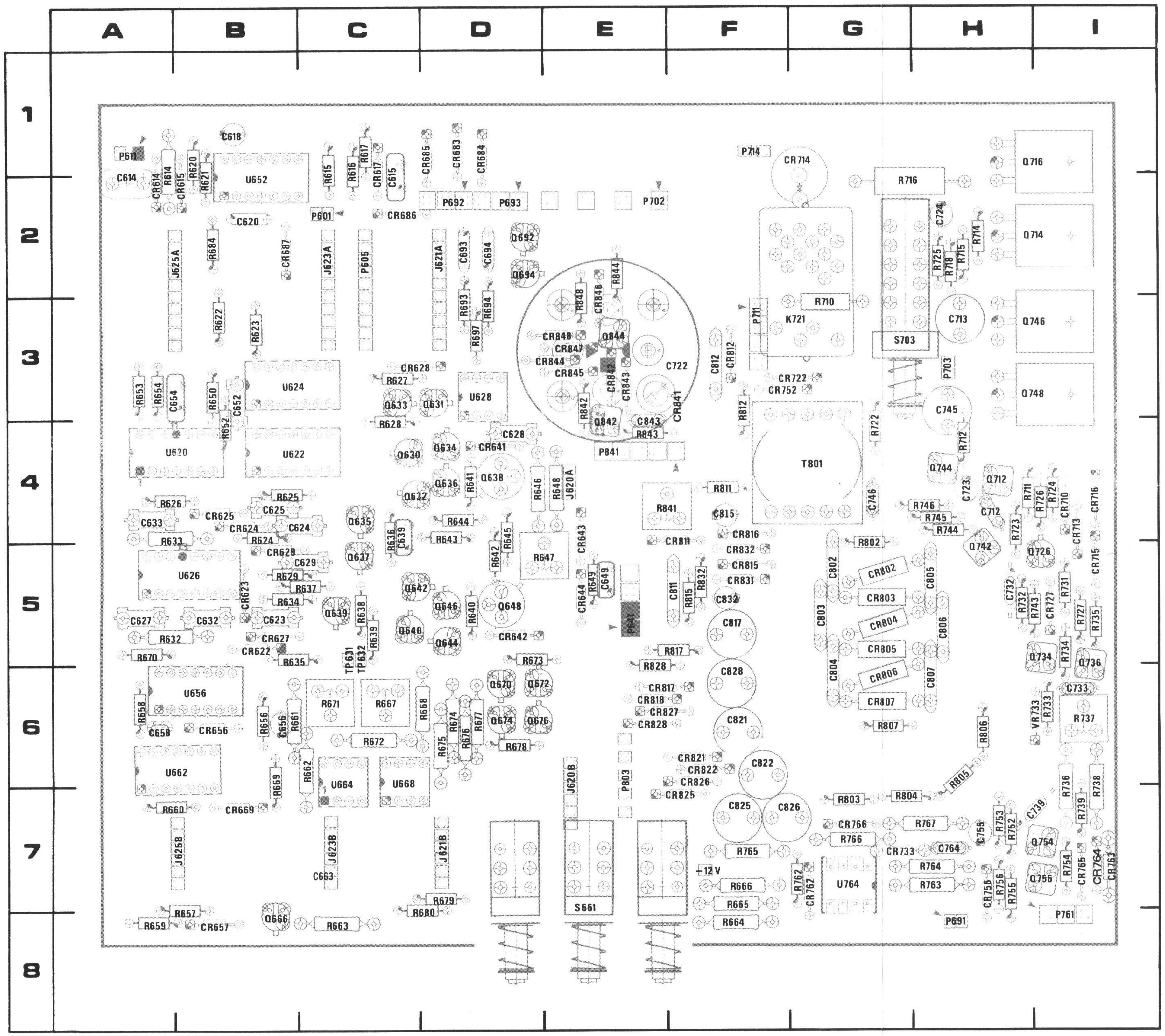
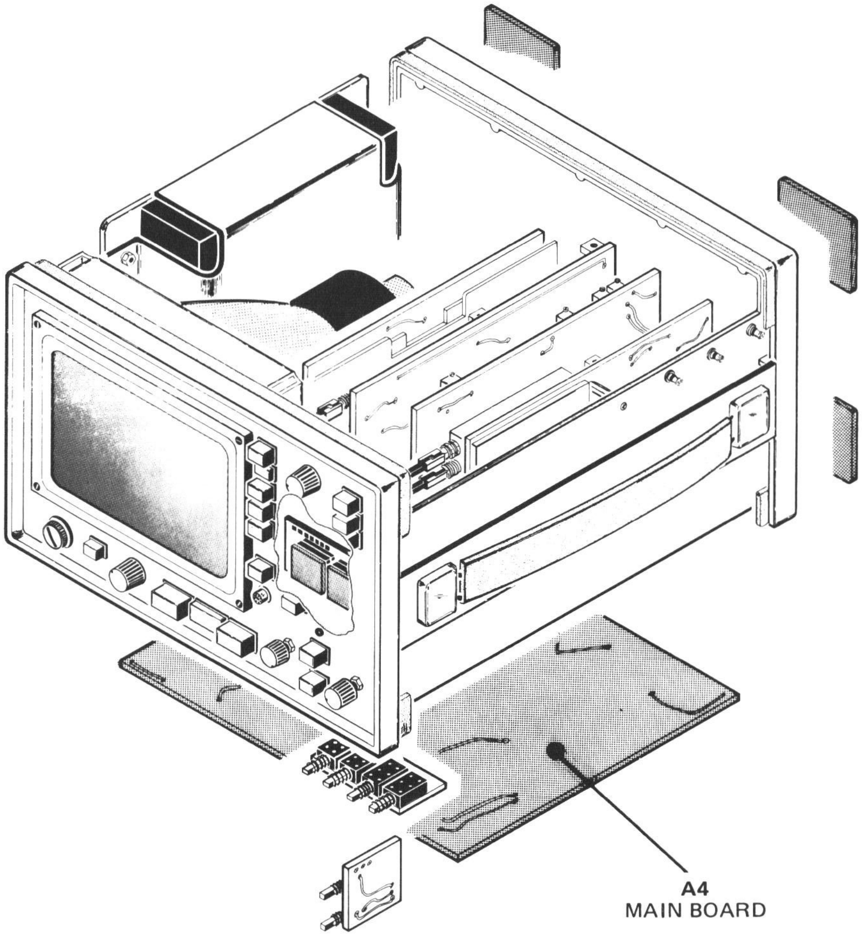


Fig. 8-9. A4—Main board component locations.

MORE

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C614	2A	CR669	7B	P703	3H	R641	4D	R746	4H
C615	2C	CR683	1D	P711	3F	R642	5D	R752	7H
C618	1B	CR684	1D	P714	1F	R643	4D	R753	7H
C620	2B	CR685	1D	P761	8I	R644	4D	R754	7I
C623	5B	CR686	2C	P803	6E	R645	4D	R755	7H
C624	4B	CR687	2B	P841	4E	R646	4D	R756	7H
C625	4B	CR710	4I			R647	5E	R762	7G
C627	5A	CR713	4I	Q630	4C	R648	4E	R763	7H
C628	4D	CR714	1G	Q631	3D	R649	5E	R764	7H
C629	5C	CR715	5I	Q632	4C	R650	3B	R765	7F
C632	5B	CR716	4I	Q633	3C	R652	4B	R766	7G
C633	4A	CR722	3G	Q634	4D	R653	3A	R767	7H
C639	4C	CR727	5I	Q635	4C	R654	3A	R802	5G
C649	5E	CR733	7G	Q636	4D	R656	6B	R803	7G
C652	3B	CR752	3F	Q637	5C	R657	8B	R804	7G
C654	3A	CR756	7H	Q638	4D	R658	6A	R805	6H
C656	6B	CR762	7G	Q639	5C	R659	8A	R806	6H
C658	6A	CR763	7I	Q640	5C	R660	7A	R807	6G
C663	7C	CR764	7I	Q642	5C	R661	6B	R811	4F
C693	2D	CR765	7I	Q644	5D	R662	6C	R812	3F
C694	2D	CR766	7G	Q646	5D	R663	8C	R815	5F
C712	4H	CR802	5G	Q648	5D	R664	8F	R817	5F
C713	3H	CR803	5G	Q666	8B	R665	7F	R828	6E
C722	3F	CR804	5G	Q670	6D	R666	7F	R832	5F
C723	4H	CR805	5G	Q672	6D	R667	6C	R841	4E
C724	2H	CR806	6G	Q674	6D	R668	6D	R842	3E
C732	5H	CR807	6G	Q676	6D	R669	6B	R843	4E
C733	6I	CR811	4F	Q692	2D	R670	5A	R844	2E
C739	7I	CR812	3F	Q694	2D	R671	6C	R848	3E
C745	3H	CR815	5F	Q712	4H	R672	6C		
C746	4G	CR816	4F	Q714	2I	R673	5D	S661	7E
C755	7H	CR817	6E	Q716	1I	R674	6D	S703	3G
C764	7H	CR818	6E	Q726	5I	R675	6D		
C802	5G	CR821	6F	Q734	5I	R676	6D	T801	4G
C803	5G	CR822	6F	Q736	6I	R677	6D		
C804	6G	CR825	7F	Q742	5H	R678	6D	TP−12V	7F
C805	5H	CR826	6F	Q744	4H	R679	7D	TP631	5C
C806	5H	CR827	6E	Q746	3I	R680	8D	TP632	5C
C807	6H	CR828	6E	Q748	3I	R684	2B		
C811	5F	CR831	5F	Q754	7I	R693	3D	U620	4B
C812	3F	CR832	5F	Q756	7I	R694	3D	U622	4B
C815	4F	CR841	3F	Q842	4E	R697	3E	U624	3B
C817	5F	CR842	3E	Q844	3E	R710	3G	U626	5B
C821	6F	CR843	3E			R711	4H	U628	3D
C822	6F	CR844	3E	R614	1A	R712	4H	U652	2B
C825	7F	CR845	3E	R615	1C	R714	2H	U656	6B
C826	7G	CR846	3E	R616	1C	R715	2H	U662	6B
C828	6F	CR847	3E	R617	1C	R716	2G	U664	6C
C832	5F	CR848	3E	R620	1B	R718	2H	U668	6C
C843	4E			R621	2B	R722	4G	U764	7B
		J620A	4E	R622	3B	R723	4H		
CR614	2A	J620B	6E	R623	3B	R724	4I	VR733	6I
CR615	2B	J621A	2D	R624	4B	R725	2H		
CR617	1C	J621B	7D	R625	4B	R726	4I		
CR622	5B	J623A	2C	R626	4A	R727	5I		
CR623	5B	J623B	7C	R627	3C	R731	5I		
CR624	4B	J625A	2B	R628	4C	R732	5H		
CR625	4B	J625B	7B	R629	5B	R733	6I		
CR627	5B			R632	5A	R734	5I		
CR628	3C	K721	3G	R633	4A	R735	5I		
CR629	5B	P601	2C	R634	5B	R736	7I		
CR641	4D	P605	2C	R635	5B	R737	6I		
CR642	5D	P611	1A	R636	4C	R738	7I		
CR643	4E	P641	5E	R637	5C	R739	7I		
CR644	5E	P691	8H	R638	5C	R743	5I		
CR656	6B	P692	2D	R639	5C	R744	4H		
CR657	8B	P693	2D	R640	5D	R745	4H		
		P702	2E						


A4
MAIN BOARD

CURRENT AND VOLTAGE CONDITIONS

Monitor is operating on 115 V ac line with fully charged battery. Currents and voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

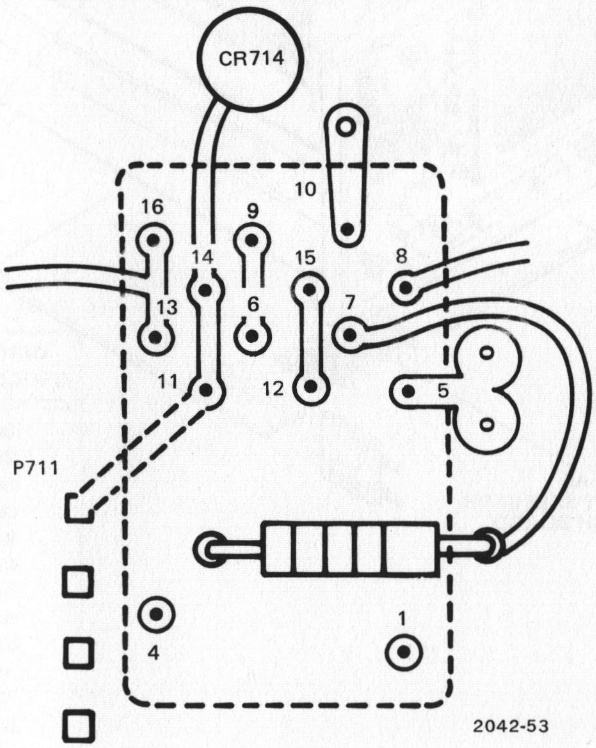
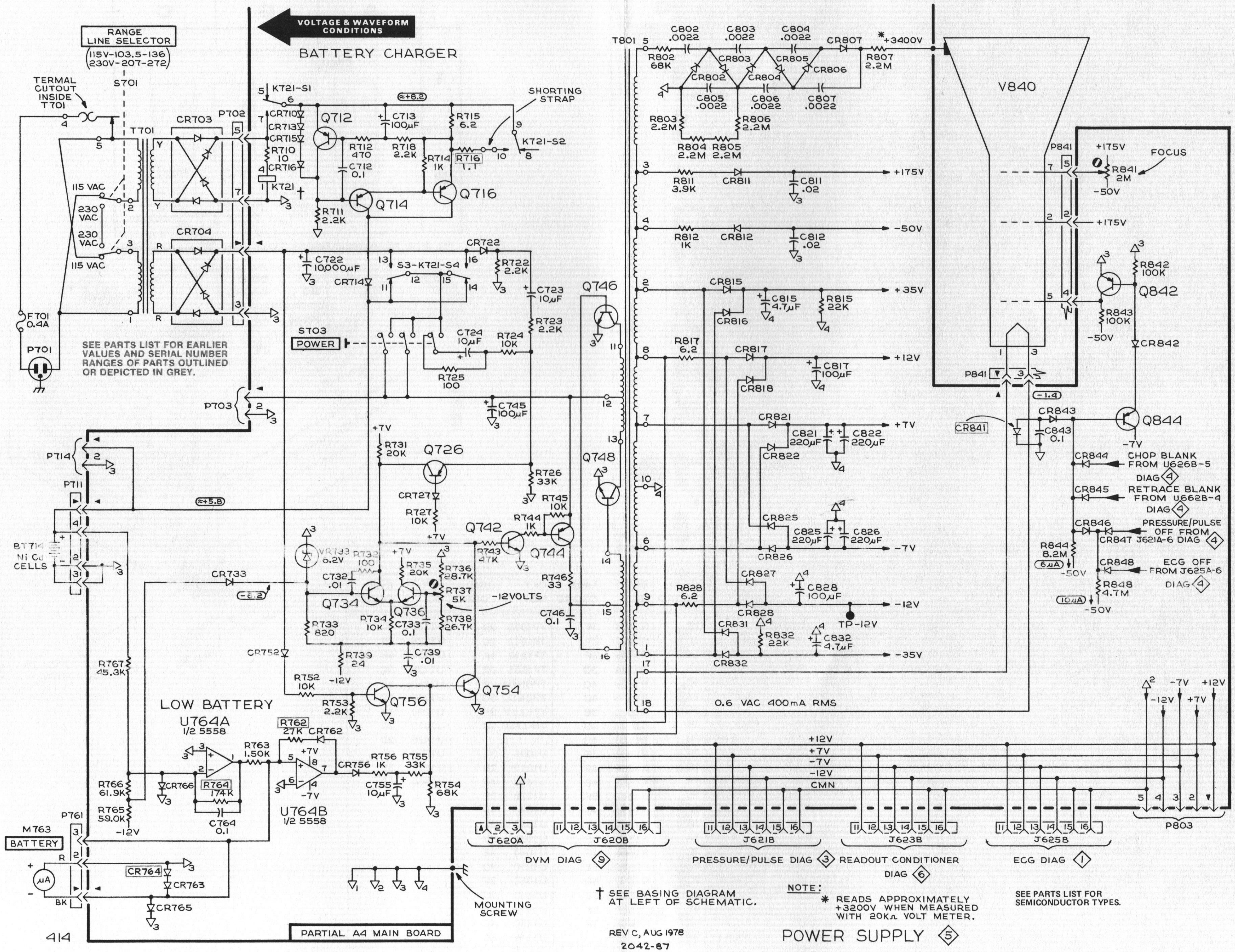


Fig. 8-10. K721 relay pin configuration.


VOLTAGE & WAVEFORM CONDITIONS
BATTERY CHARGER
RANGE LINE SELECTOR
115V-103.5-136
230V-207-272
TERMAL CUTOUT INSIDE T701
SHORTING STRAP
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
POWER
LOW BATTERY
U764A 1/2 5558
U764B 1/2 5558
BATTERY
PARTIAL A4 MAIN BOARD
MOUNTING SCREW
414
-12VOLTS
V840
FOCUS
CHOP BLANK FROM U626B-5 DIAG 4
RETRACE BLANK FROM U626B-4 DIAG 4
PRESSURE/PULSE OFF FROM J621A-6 DIAG 4
ECG OFF FROM J625A-6 DIAG 4
0.6 VAC 400mA RMS
DVM DIAG 9
PRESSURE/PULSE DIAG 3
READOUT CONDITIONER DIAG 6
ECG DIAG 1
† SEE BASING DIAGRAM AT LEFT OF SCHEMATIC.
NOTE: * READS APPROXIMATELY +3200V WHEN MEASURED WITH 20KΩ VOLT METER.
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
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POWER SUPPLY 5

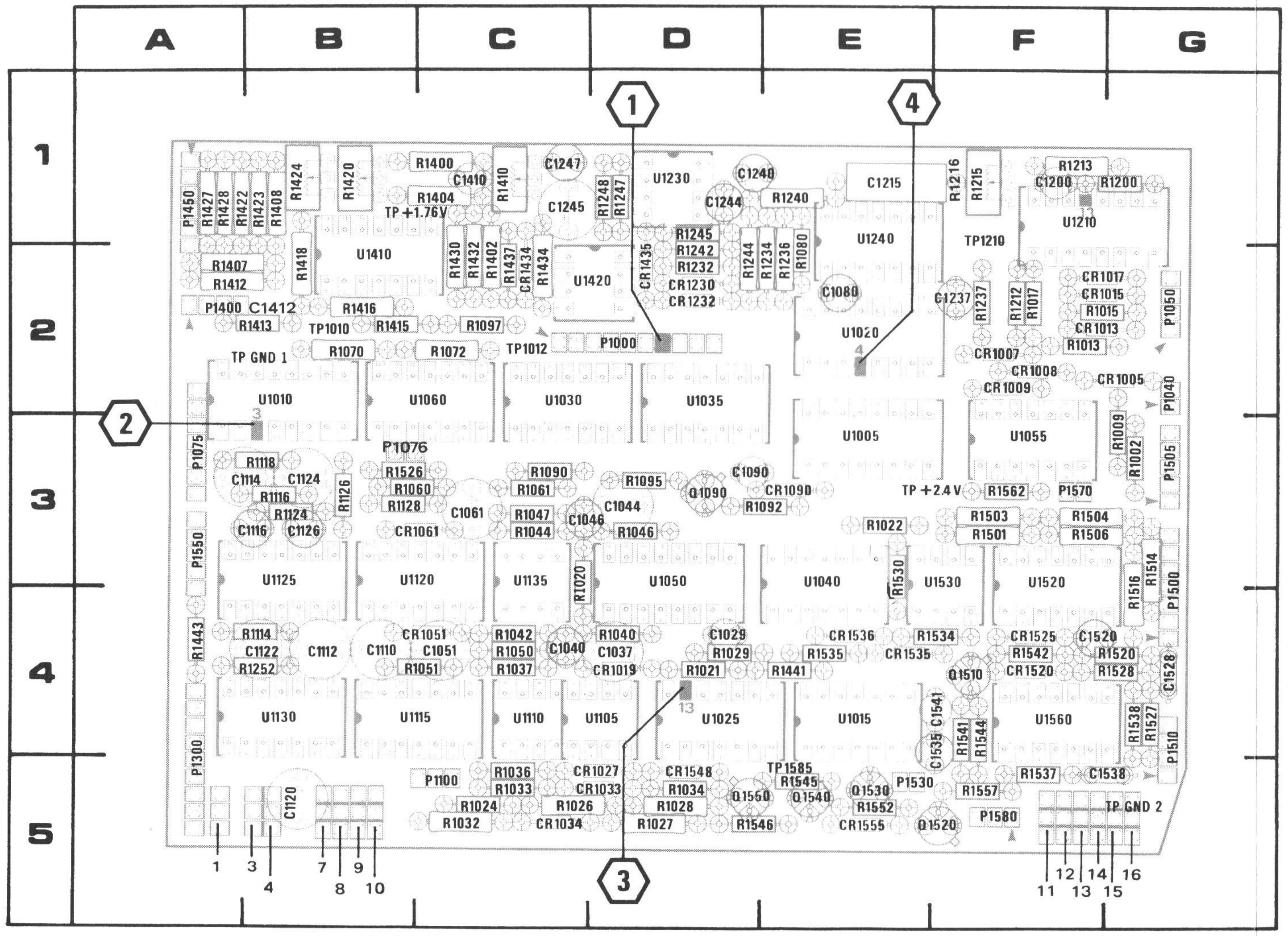


Fig. 8-11. A3—Readout Conditioner board component locations.

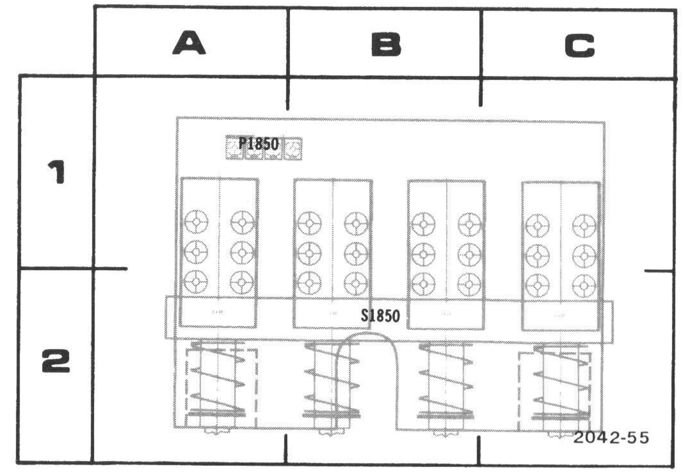
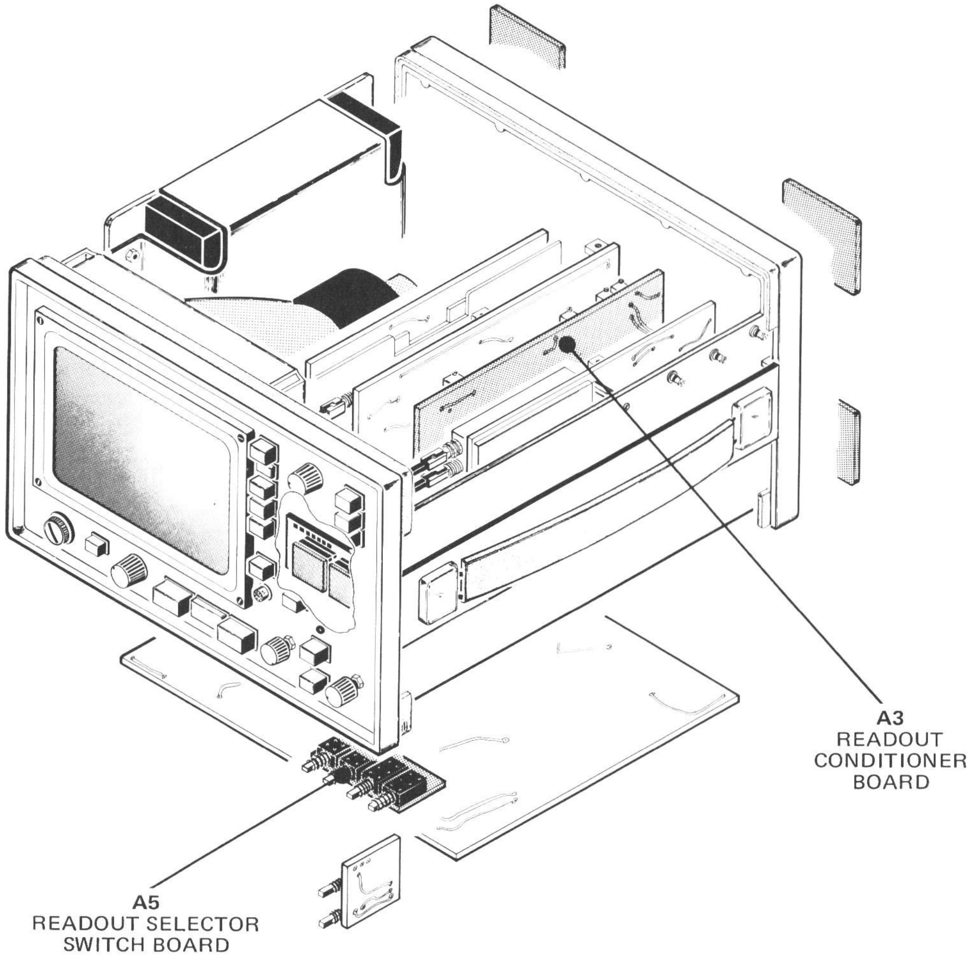


Fig. 8-12. A5—Readout Selector Switch board component locations.

CKT NO	GRID COORD
P1850	1A
S1850	2B

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C1029	4D	C1247	1C	CR1230	2D	P1530	5E	R1028	5D	R1114	4B	R1402	2C	R1503	3F	TP1010	2B	U1120	3C
C1037	4D	C1410	1C	CR1232	2D	P1550	3A	R1029	4D	R1116	3B	R1404	1C	R1504	3F	TP1012	2C	U1125	3B
C1040	4C	C1412	2B	CR1434	2C	P1570	3F	R1032	5C	R1118	3B	R1407	2A	R1506	3F	TP1210	1F	U1130	4B
C1044	3D	C1520	4F	CR1435	2D	P1580	5F	R1033	5C	R1124	3B	R1408	1B	R1514	3G	TP1585	5E	U1135	3C
C1046	3C	C1528	4G	CR1520	4F			R1034	5D	R1126	3B	R1410	1C	R1516	4G	TPGND1	2B	U1210	1F
C1051	4C	C1535	4F	CR1525	4F	Q1090	3D	R1036	5C	R1128	3B	R1412	2A	R1520	4G	TPGND2	5G	U1230	1D
C1061	3C	C1538	5G	CR1535	4E	Q1510	4F	R1037	4C	R1200	1G	R1413	2B	R1526	3B	TP+2.4V	3F	U1240	1E
C1080	2E	C1541	4F	CR1536	4E	Q1520	5F	R1040	4D	R1212	2F	R1415	2B	R1527	4G	TP+1.76V	1C	U1410	2B
C1090	3D			CR1548	5D	Q1530	5E	R1042	4C	R1213	1F	R1416	2B	R1528	4G			U1420	2D
C1110	4B	CR1005	2G	CR1555	5E	Q1540	5E	R1044	3C	R1215	1F	R1418	2B	R1530	3E	U1005	3E	U1520	3F
C1112	4B	CR1007	2F			Q1550	5D	R1046	3D	R1216	1F	R1420	1B	R1534	4F	U1010	2B	U1530	3F
C1114	3B	CR1008	2F	P1000	2D			R1047	3C	R1232	2D	R1422	1A	R1535	4E	U1015	4E	U1560	4F
C1116	3B	CR1009	2F	P1040	2G	R1002	3G	R1050	4C	R1234	2E	R1423	1B	R1537	5F	U1020	2E		
C1120	5B	CR1013	2F	P1050	2G	R1009	3G	R1051	4C	R1236	2E	R1424	1B	R1538	4G	U1025	4D		
C1122	4B	CR1015	2G	P1075	3A	R1013	2F	R1060	3B	R1237	2F	R1427	1A	R1541	4F	U1030	2C		
C1124	3B	CR1017	2G	P1076	3B	R1015	2G	R1061	3C	R1240	1E	R1428	1A	R1542	4F	U1035	2D		
C1126	3B	CR1019	4D	P1100	5C	R1017	2F	R1070	2B	R1242	2D	R1430	2C	R1544	4F	U1040	3E		
C1200	1F	CR1027	5D	P1300	5A	R1020	3C	R1072	2C	R1244	2D	R1432	2C	R1545	5E	U1050	3D		
C1215	1E	CR1033	5D	P1400	2A	R1021	4D	R1080	2E	R1245	1D	R1434	2C	R1546	5D	U1055	3F		
C1237	2F	CR1034	5C	P1450	1A	R1022	3E	R1090	3C	R1247	1D	R1437	2C	R1552	5E	U1060	2C		
C1240	1D	CR1051	4C	P1500	4G	R1024	5C	R1092	3E	R1248	1D	R1441	4E	R1557	5F	U1105	4D		
C1244	1D	CR1061	3C	P1510	4G	R1026	5C	R1095	3D	R1252	4B	R1443	4A	R1562	3F	U1110	4C		
C1245	1C	CR1090	3E	P1505	3G	R1027	5D	R1097	2C	R1400	1C	R1501	3F			U1115	4C		

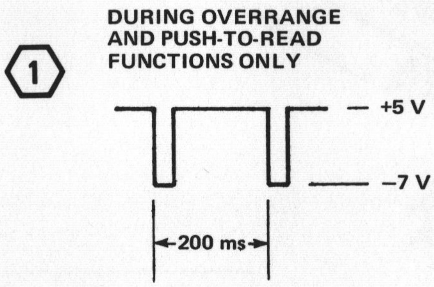
MORE ➡

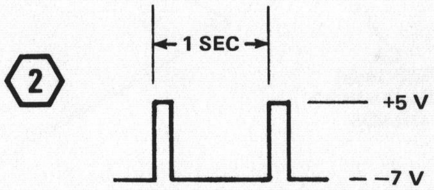

A3
READOUT
CONDITIONER
BOARD
A5
READOUT SELECTOR
SWITCH BOARD

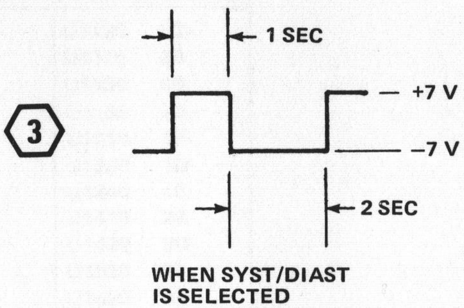
VOLTAGE AND WAVEFORM CONDITIONS

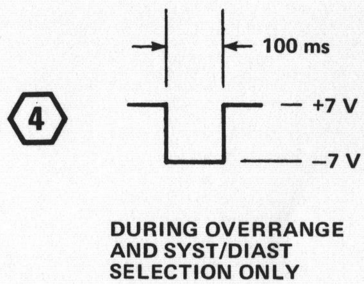
Voltages are design-center values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

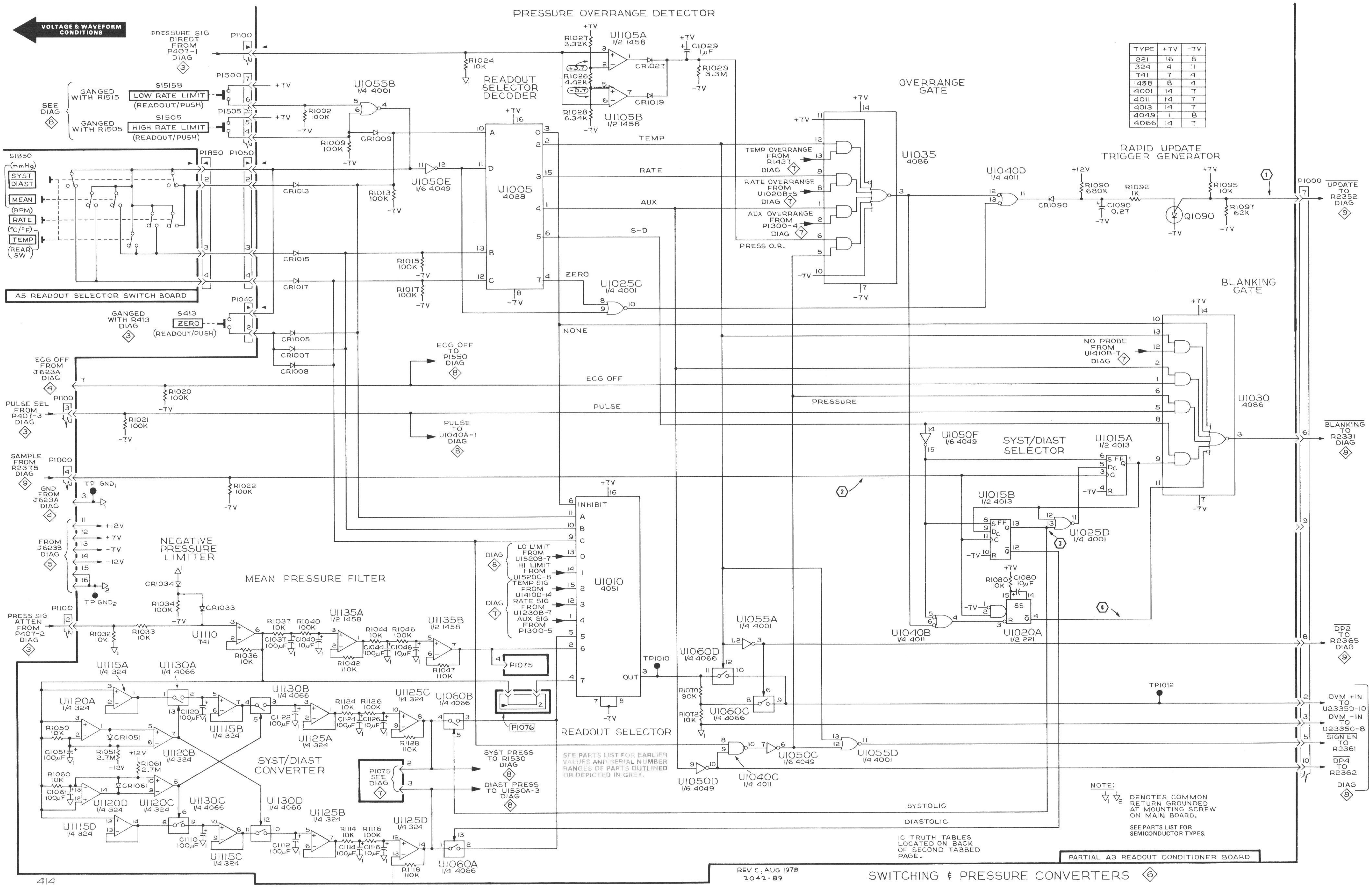
Waveforms are idealized and may vary from actual test-oscilloscope waveforms.











TYPE	+7V	-7V
221	16	8
324	4	11
741	7	4
1458	8	4
4001	14	7
4011	14	7
4013	14	7
4049	1	8
4066	14	7

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SWITCHING & PRESSURE CONVERTERS ⑥

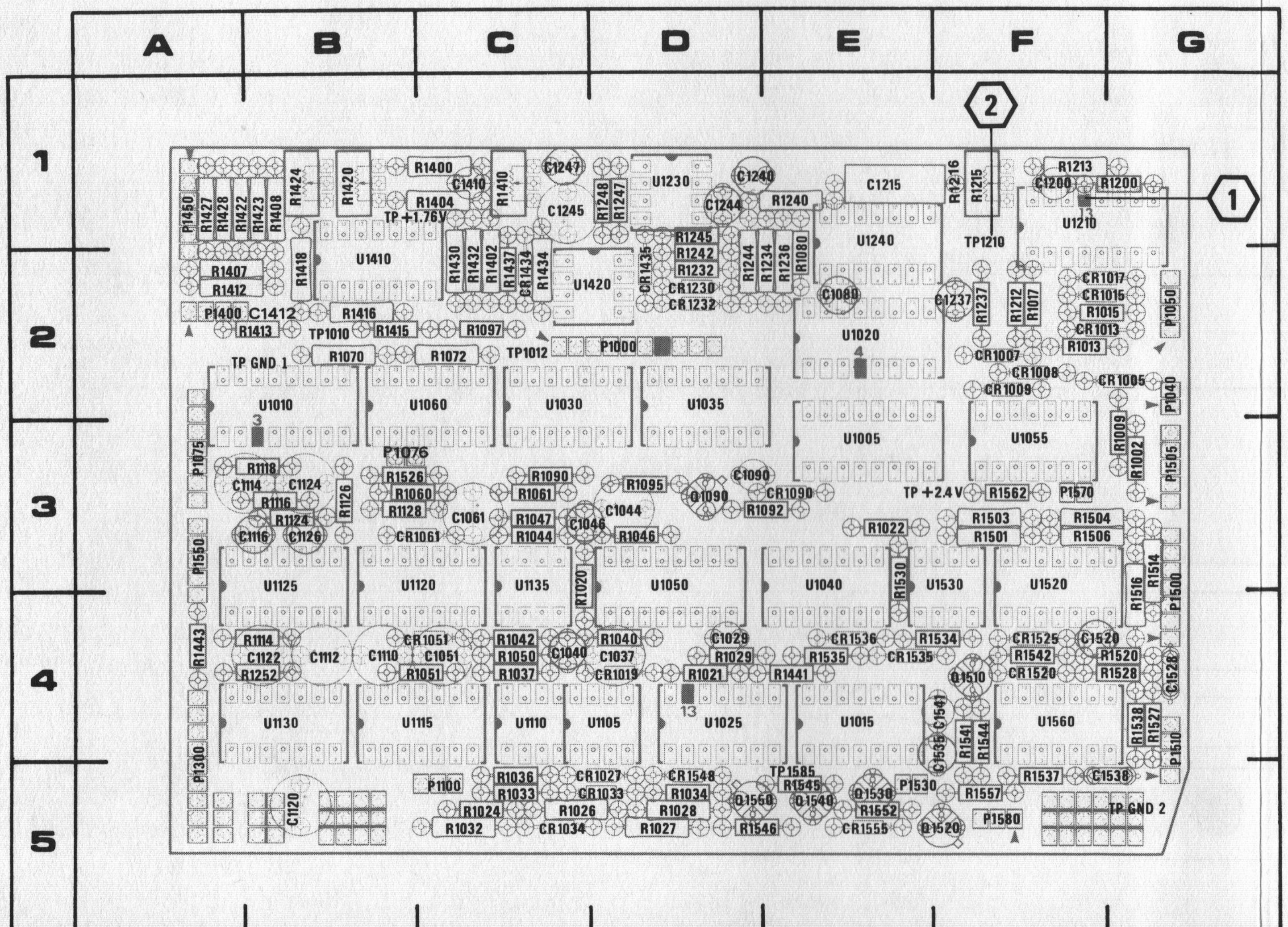
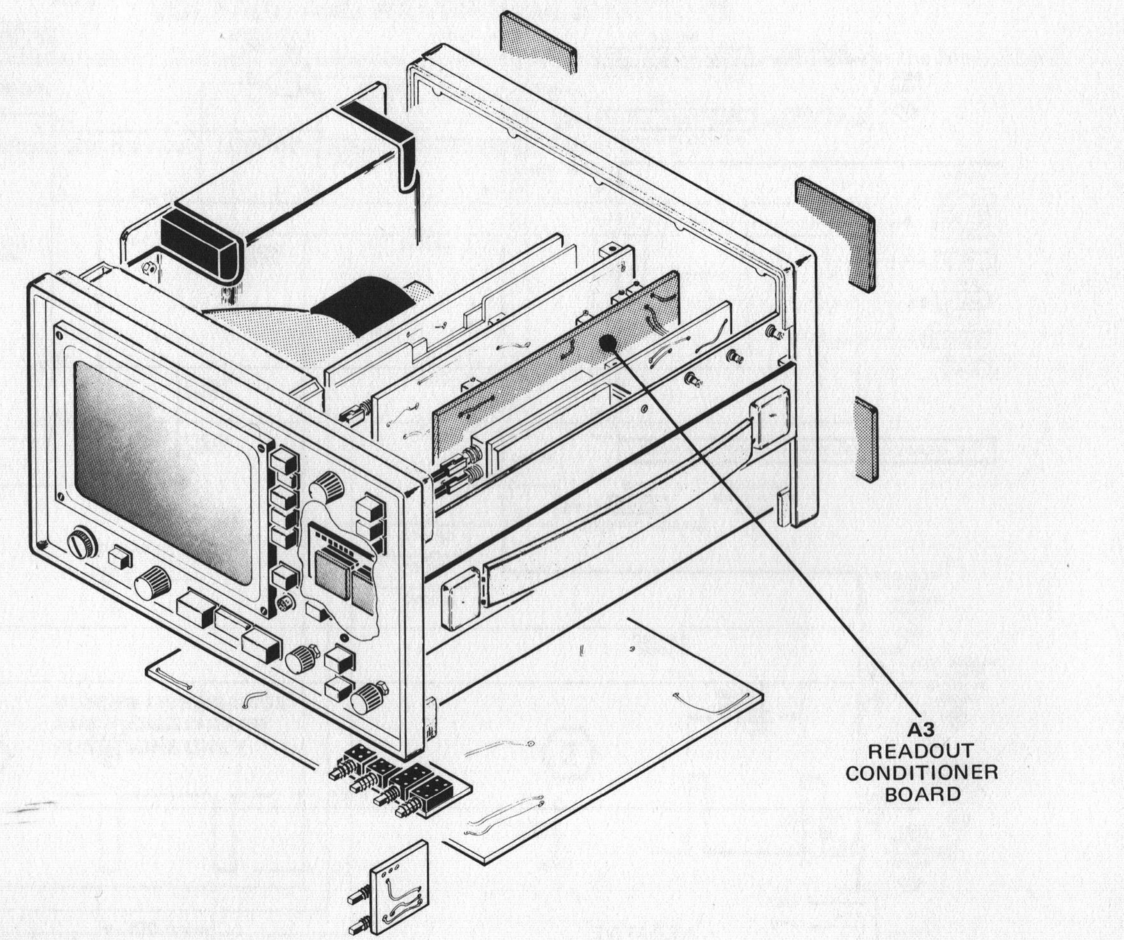


Fig. 8-13. A3—Readout Conditioner board component locations.



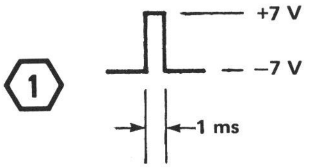
CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C1029	4D	C1247	1C	CR1230	2D	P1530	5E	R1028	5D	R1114	4B	R1402	2C	R1503	3F	TP1010	2B	U1120	3C
C1037	4D	C1410	1C	CR1232	2D	P1550	3A	R1029	4D	R1116	3B	R1404	1C	R1504	3F	TP1012	2C	U1125	3B
C1040	4C	C1412	2B	CR1434	2C	P1570	3F	R1032	5C	R1118	3B	R1407	2A	R1506	3F	TP1210	1F	U1130	4B
C1044	3D	C1520	4F	CR1435	2D	P1580	5F	R1033	5C	R1124	3B	R1408	1B	R1514	3G	TP1585	5E	U1135	3C
C1046	3C	C1528	4G	CR1520	4F			R1034	5D	R1126	3B	R1410	1C	R1516	4G	TPGND1	2B	U1210	1F
C1051	4C	C1535	4F	CR1525	4F	Q1090	3D	R1036	5C	R1128	3B	R1412	2A	R1520	4G	TPGND2	5G	U1230	1D
C1061	3C	C1538	5G	CR1535	4E	Q1510	4F	R1037	4C	R1200	1G	R1413	2B	R1526	3B	TP+2.4V	3F	U1240	1E
C1080	2E	C1541	4F	CR1536	4E	Q1520	5F	R1040	4D	R1212	2F	R1415	2B	R1527	4G	TP+1.76V	1C	U1410	2B
C1090	3D			CR1548	5D	Q1530	5E	R1042	4C	R1213	1F	R1416	2B	R1528	4G			U1420	2D
C1110	4B	CR1005	2G	CR1555	5E	Q1540	5E	R1044	3C	R1215	1F	R1418	2B	R1530	3E	U1005	3E	U1520	3F
C1112	4B	CR1007	2F			Q1550	5D	R1046	3D	R1216	1F	R1420	1B	R1534	4F	U1010	2B	U1530	3F
C1114	3B	CR1008	2F	P1000	2D			R1047	3C	R1232	2D	R1422	1A	R1535	4E	U1015	4E	U1560	4F
C1116	3B	CR1009	2F	P1040	2G	R1002	3G	R1050	4C	R1234	2E	R1423	1B	R1537	5F	U1020	2E		
C1120	5B	CR1013	2F	P1050	2G	R1009	3G	R1051	4C	R1236	2E	R1424	1B	R1538	4G	U1025	4D		
C1122	4B	CR1015	2G	P1075	3A	R1013	2F	R1060	3B	R1237	2F	R1427	1A	R1541	4F	U1030	2C		
C1124	3B	CR1017	2G	P1076	3B	R1015	2G	R1061	3C	R1240	1E	R1428	1A	R1542	4F	U1035	2D		
C1126	3B	CR1019	4D	P1100	5C	R1017	2F	R1070	2B	R1242	2D	R1430	2C	R1544	4F	U1040	3E		
C1200	1F	CR1027	5D	P1300	5A	R1020	3C	R1072	2C	R1244	2D	R1432	2C	R1545	5E	U1050	3D		
C1215	1E	CR1033	5D	P1400	2A	R1021	4D	R1080	2E	R1245	1D	R1434	2C	R1546	5D	U1055	3F		
C1237	2F	CR1034	5C	P1450	1A	R1022	3E	R1090	3C	R1247	1D	R1437	2C	R1552	5E	U1060	2C		
C1240	1D	CR1051	4C	P1500	4G	R1024	5C	R1092	3E	R1248	1D	R1441	4E	R1557	5F	U1105	4D		
C1244	1D	CR1061	3C	P1510	4G	R1026	5C	R1095	3D	R1252	4B	R1443	4A	R1562	3F	U1110	4C		
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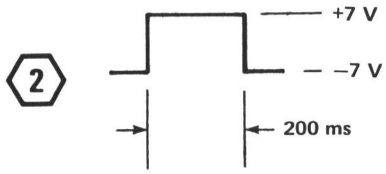
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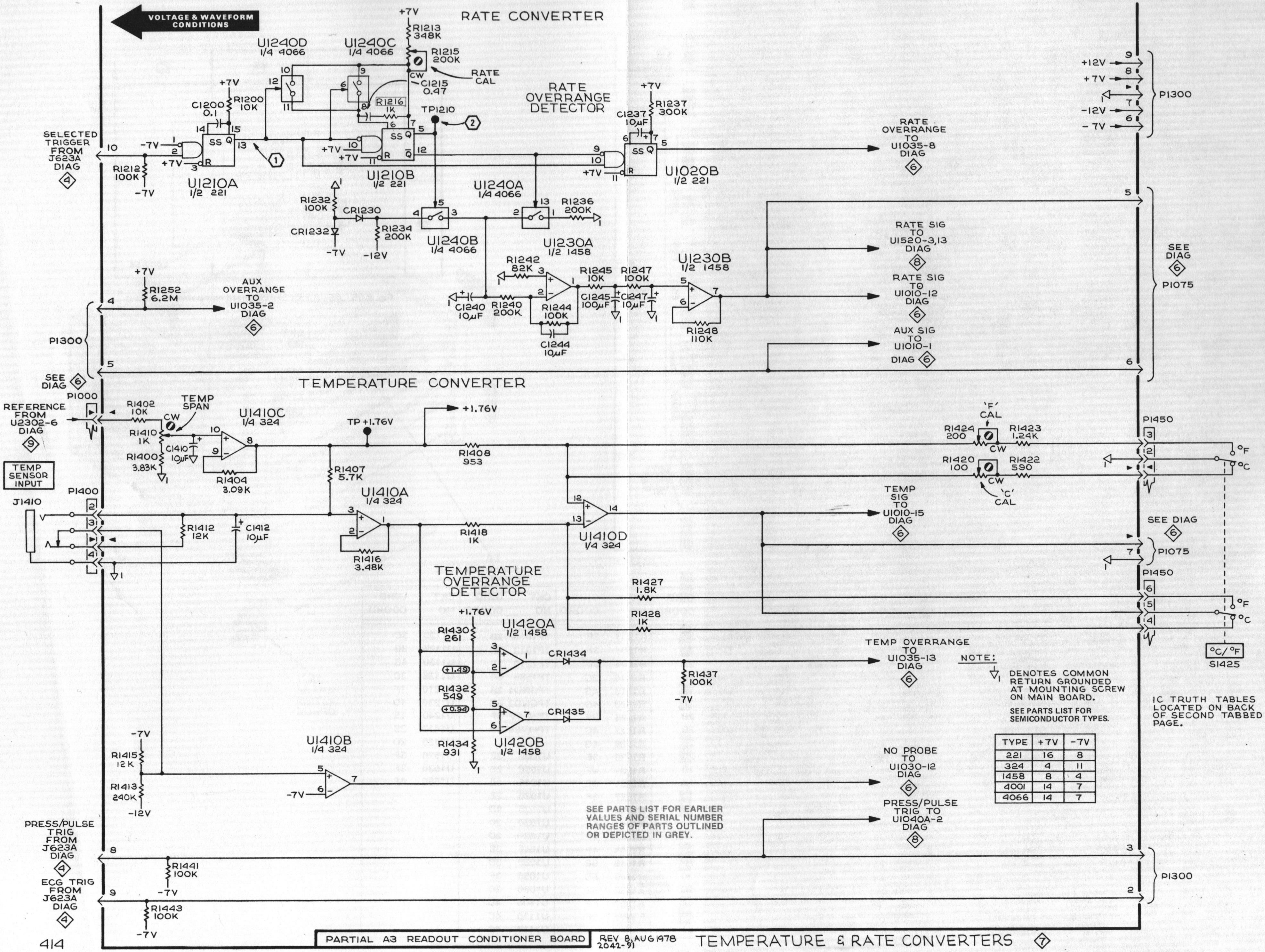
VOLTAGE AND WAVEFORM CONDITIONS

Voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

Waveforms are idealized and may vary from actual test-oscilloscope waveform. A rate signal must be applied to the 414 from the ECG LEAD CHECK terminals or a pulse sensor.






VOLTAGE & WAVEFORM CONDITIONS
RATE CONVERTER
U1240D 1/4 4066
U1240C 1/4 4066
R1213 348K
R1215 200K
RATE CAL
C1215 0.47
R1216 1K
C1200 0.1
R1200 10K
TP1210
RATE OVERRANGE DETECTOR
C1237 10µF
R1237 300K
SELECTED TRIGGER FROM J623A DIAG 4
R1212 100K
U1210A 1/2 221
U1210B 1/2 221
U1020B 1/2 221
RATE OVERRANGE TO U1035-8 DIAG 6
U1240A 1/4 4066
R1232 100K
CR1230
CR1232
R1234 200K
U1240B 1/4 4066
R1236 200K
U1230A 1/2 1458
U1230B 1/2 1458
R1242 82K
R1245 10K
R1247 100K
C1245 100µF
C1247 10µF
C1240 10µF
R1240 200K
R1244 100K
C1244 10µF
R1248 110K
RATE SIG TO U1520-3,13 DIAG 8
RATE SIG TO U1010-12 DIAG 6
AUX SIG TO U1010-1 DIAG 6
R1252 6.2M
AUX OVERRANGE TO U1035-2 DIAG 6
P1300
SEE DIAG 6
P1075
TEMPERATURE CONVERTER
REFERENCE FROM U2302-6 DIAG 9
P1000
R1402 10K
TEMP SPAN
R1410 1K
R1400 3.83K
C1410 10µF
U1410C 1/4 324
R1404 3.09K
TP +1.76V
+1.76V
R1408 953
R1407 5.7K
TEMP SENSOR INPUT
P1400
J1410
R1412 12K
C1412 10µF
U1410A 1/4 324
R1416 3.48K
R1418 1K
U1410D 1/4 324
'F' CAL
R1424 200
R1423 1.24K
R1420 100
R1422 590
'C' CAL
P1450
TEMP SIG TO U1010-15 DIAG 6
SEE DIAG 6
R1427 1.8K
R1428 1K
TEMPERATURE OVERRANGE DETECTOR
R1430 261
U1420A 1/2 1458
CR1434
R1432 549
CR1435
U1420B 1/2 1458
R1434 931
R1437 100K
TEMP OVERRANGE TO U1035-13 DIAG 6
°C/°F S1425
NOTE: DENOTES COMMON RETURN GROUNDED AT MOUNTING SCREW ON MAIN BOARD.
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
IC TRUTH TABLES LOCATED ON BACK OF SECOND TABBED PAGE.
TYPE | +7V | -7V
221 | 16 | 8
324 | 4 | 11
1458 | 8 | 4
4001 | 14 | 7
4066 | 14 | 7
R1415 12K
R1413 240K
U1410B 1/4 324
NO PROBE TO U1030-12 DIAG 6
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
PRESS/PULSE TRIG TO U1040A-2 DIAG 8
PRESS/PULSE TRIG FROM J623A DIAG 4
R1441 100K
ECG TRIG FROM J623A DIAG 4
R1443 100K
PARTIAL A3 READOUT CONDITIONER BOARD
REV B AUG 1978 2042-91
TEMPERATURE & RATE CONVERTERS 7

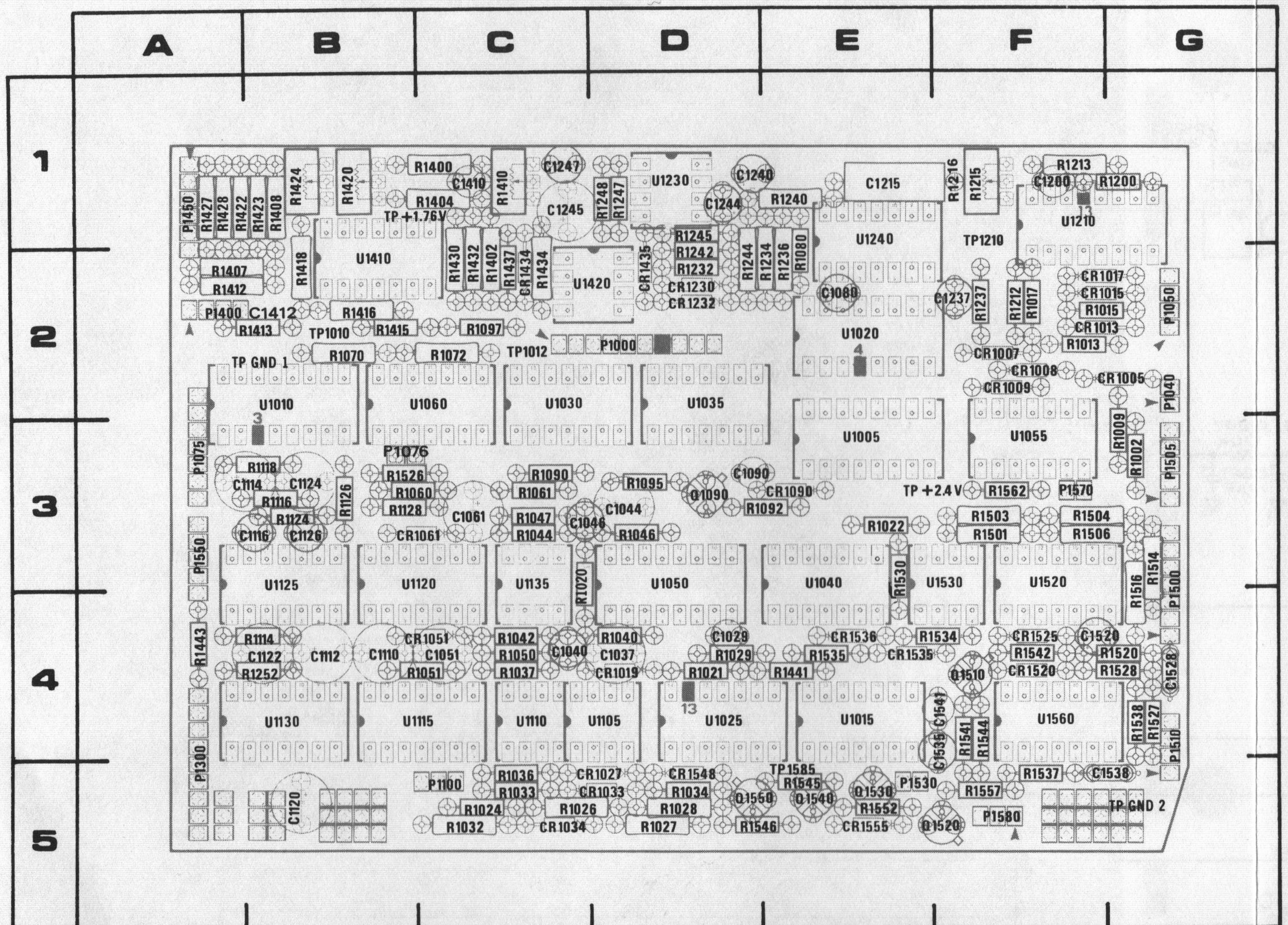


Fig. 8-14. A3—Readout Conditioner board component locations.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C1029	4D	C1247	1C	CR1230	2D	P1530	5E	R1028	5D	R1114	4B	R1402	2C	R1503	3F	TP1010	2B	U1120	3C
C1037	4D	C1410	1C	CR1232	2D	P1550	3A	R1029	4D	R1116	3B	R1404	1C	R1504	3F	TP1012	2C	U1125	3B
C1040	4C	C1412	2B	CR1434	2C	P1570	3F	R1032	5C	R1118	3B	R1407	2A	R1506	3F	TP1210	1F	U1130	4B
C1044	3D	C1520	4F	CR1435	2D	P1580	5F	R1033	5C	R1124	3B	R1408	1B	R1514	3G	TP1585	5E	U1135	3C
C1046	3C	C1528	4G	CR1520	4F			R1034	5D	R1126	3B	R1410	1C	R1516	4G	TPGND1	2B	U1210	1F
C1051	4C	C1535	4F	CR1525	4F	Q1090	3D	R1036	5C	R1128	3B	R1412	2A	R1520	4G	TPGND2	5G	U1230	1D
C1061	3C	C1538	5G	CR1535	4E	Q1510	4F	R1037	4C	R1200	1G	R1413	2B	R1526	3B	TP+2.4V	3F	U1240	1E
C1080	2E	C1541	4F	CR1536	4E	Q1520	5F	R1040	4D	R1212	2F	R1415	2B	R1527	4G	TP+1.76V	1C	U1410	2B
C1090	3D			CR1548	5D	Q1530	5E	R1042	4C	R1213	1F	R1416	2B	R1528	4G			U1420	2D
C1110	4B	CR1005	2G	CR1555	5E	Q1540	5E	R1044	3C	R1215	1F	R1418	2B	R1530	3E	U1005	3E	U1520	3F
C1112	4B	CR1007	2F			Q1550	5D	R1046	3D	R1216	1F	R1420	1B	R1534	4F	U1010	2B	U1530	3F
C1114	3B	CR1008	2F	P1000	2D			R1047	3C	R1232	2D	R1422	1A	R1535	4E	U1015	4E	U1560	4F
C1116	3B	CR1009	2F	P1040	2G	R1002	3G	R1050	4C	R1234	2E	R1423	1B	R1537	5F	U1020	2E		
C1120	5B	CR1013	2F	P1050	2G	R1009	3G	R1051	4C	R1236	2E	R1424	1B	R1538	4G	U1025	4D		
C1122	4B	CR1015	2G	P1075	3A	R1013	2F	R1060	3B	R1237	2F	R1427	1A	R1541	4F	U1030	2C		
C1124	3B	CR1017	2G	P1076	3B	R1015	2G	R1061	3C	R1240	1E	R1428	1A	R1542	4F	U1035	2D		
C1126	3B	CR1019	4D	P1100	5C	R1017	2F	R1070	2B	R1242	2D	R1430	2C	R1544	4F	U1040	3E		
C1200	1F	CR1027	5D	P1300	5A	R1020	3C	R1072	2C	R1244	2D	R1432	2C	R1545	5E	U1050	3D		
C1215	1E	CR1033	5D	P1400	2A	R1021	4D	R1080	2E	R1245	1D	R1434	2C	R1546	5D	U1055	3F		
C1237	2F	CR1034	5C	P1450	1A	R1022	3E	R1090	3C	R1247	1D	R1437	2C	R1552	5E	U1060	2C		
C1240	1D	CR1051	4C	P1500	4G	R1024	5C	R1092	3E	R1248	1D	R1441	4E	R1557	5F	U1105	4D		
C1244	1D	CR1061	3C	P1510	4G	R1026	5C	R1095	3D	R1252	4B	R1443	4A	R1562	3F	U1110	4C		
C1245	1C	CR1090	3E	P1505	3G	R1027	5D	R1097	2C	R1400	1C	R1501	3F			U1115	4C		

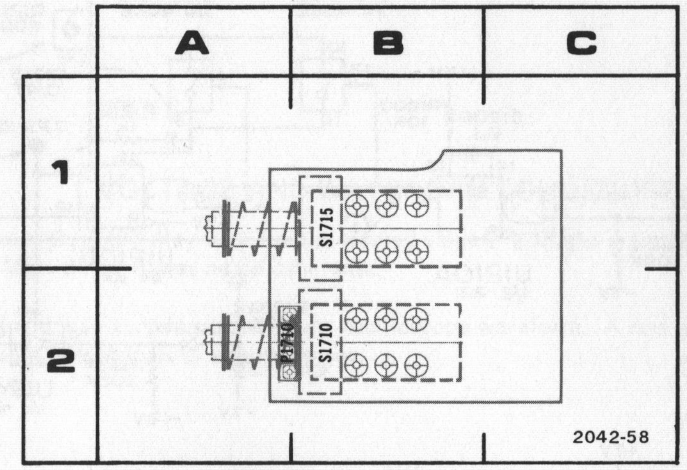
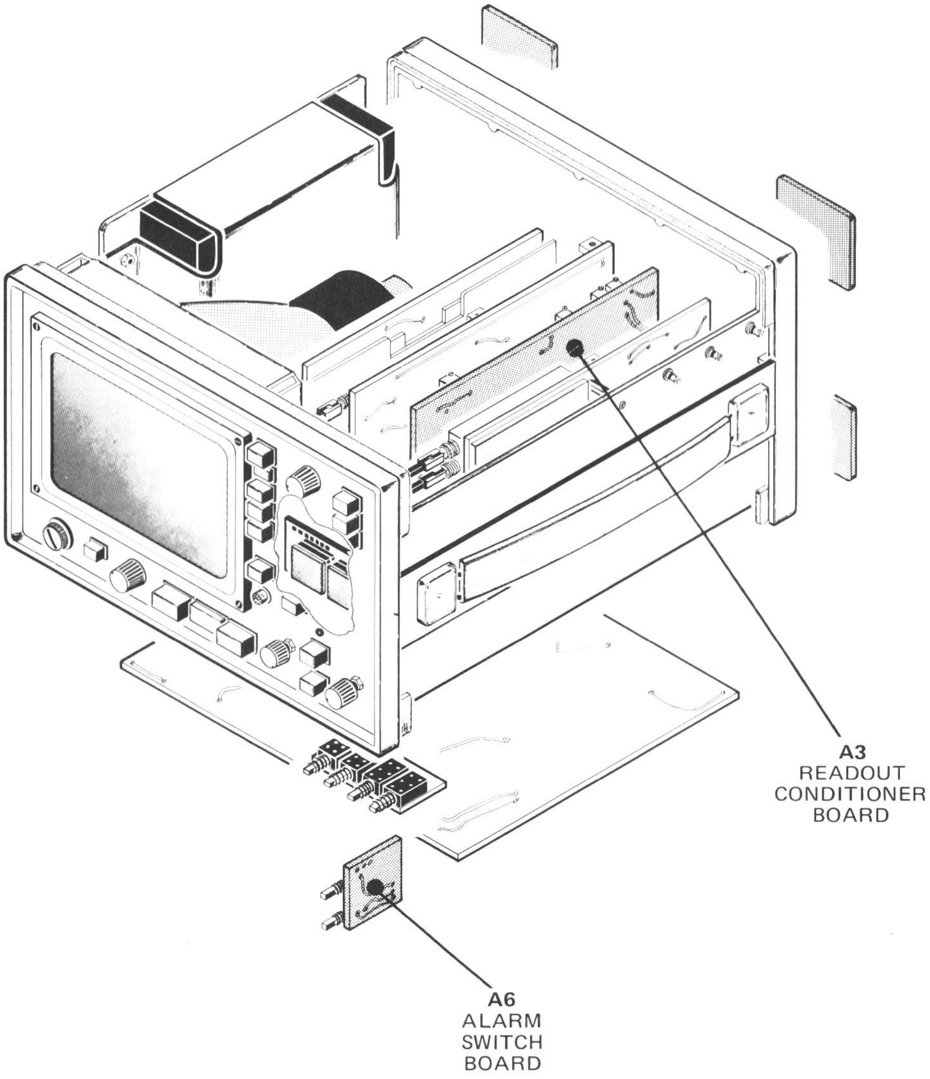


Fig. 8-15. A6—Alarm Switch board component locations.

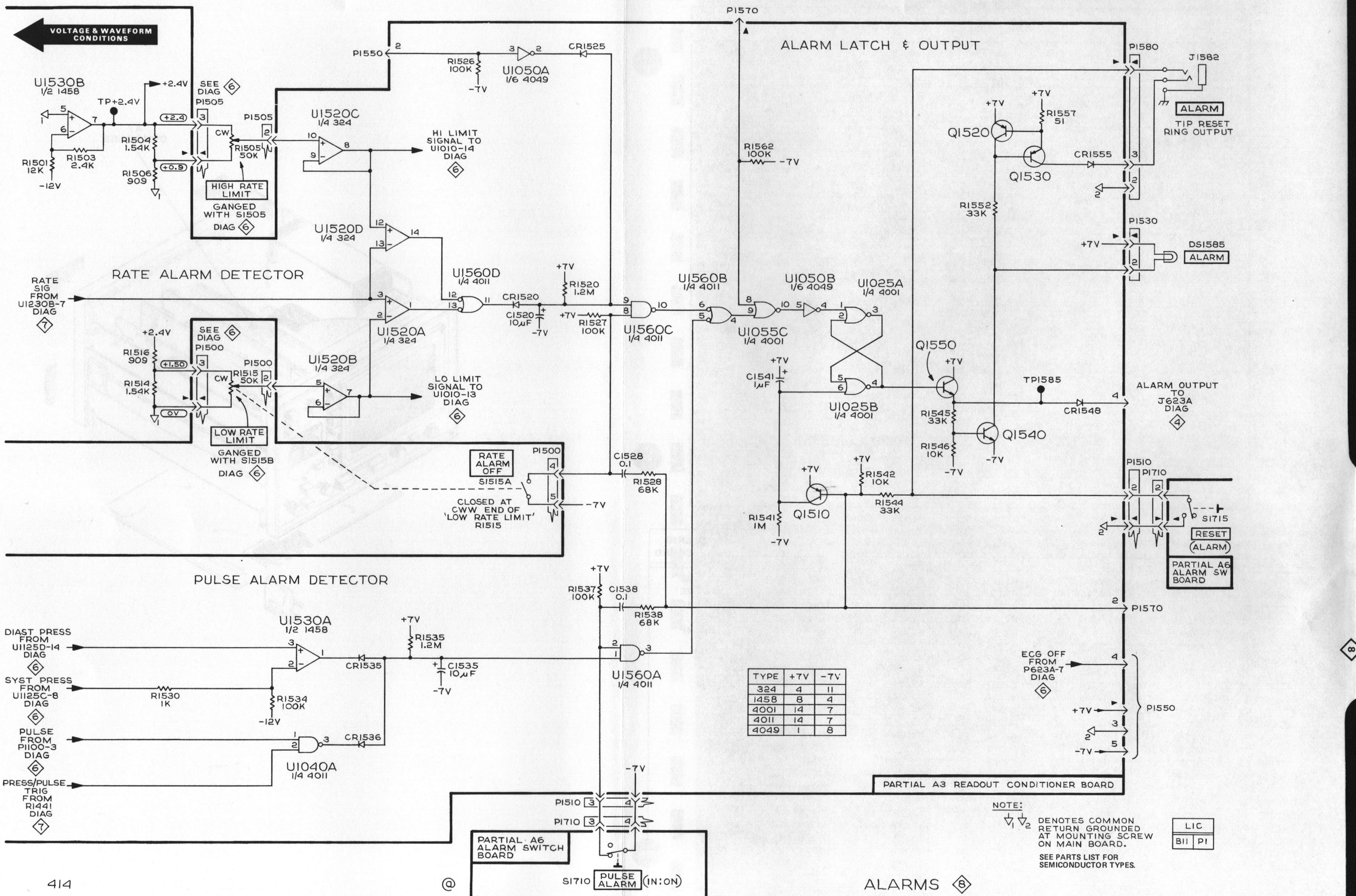
CKT NO	GRID COORD
P1710	2A
S1710	2B
S1715	1B

MORE ➔


A3
READOUT
CONDITIONER
BOARD
A6
ALARM
SWITCH
BOARD

VOLTAGE CONDITIONS

Voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.



TYPE	+7V	-7V
324	4	11
1458	8	4
4001	14	7
4011	14	7
4049	1	8

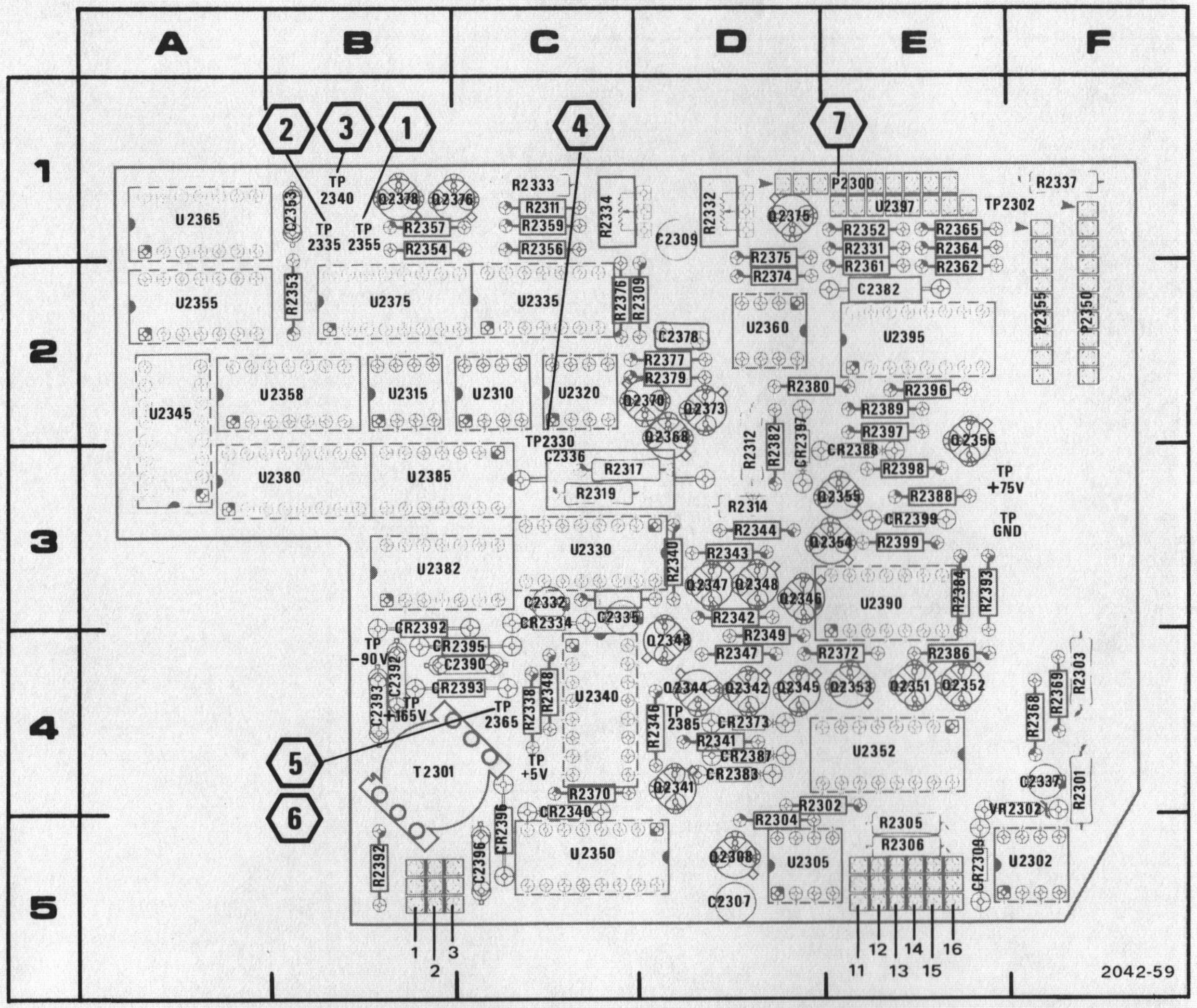
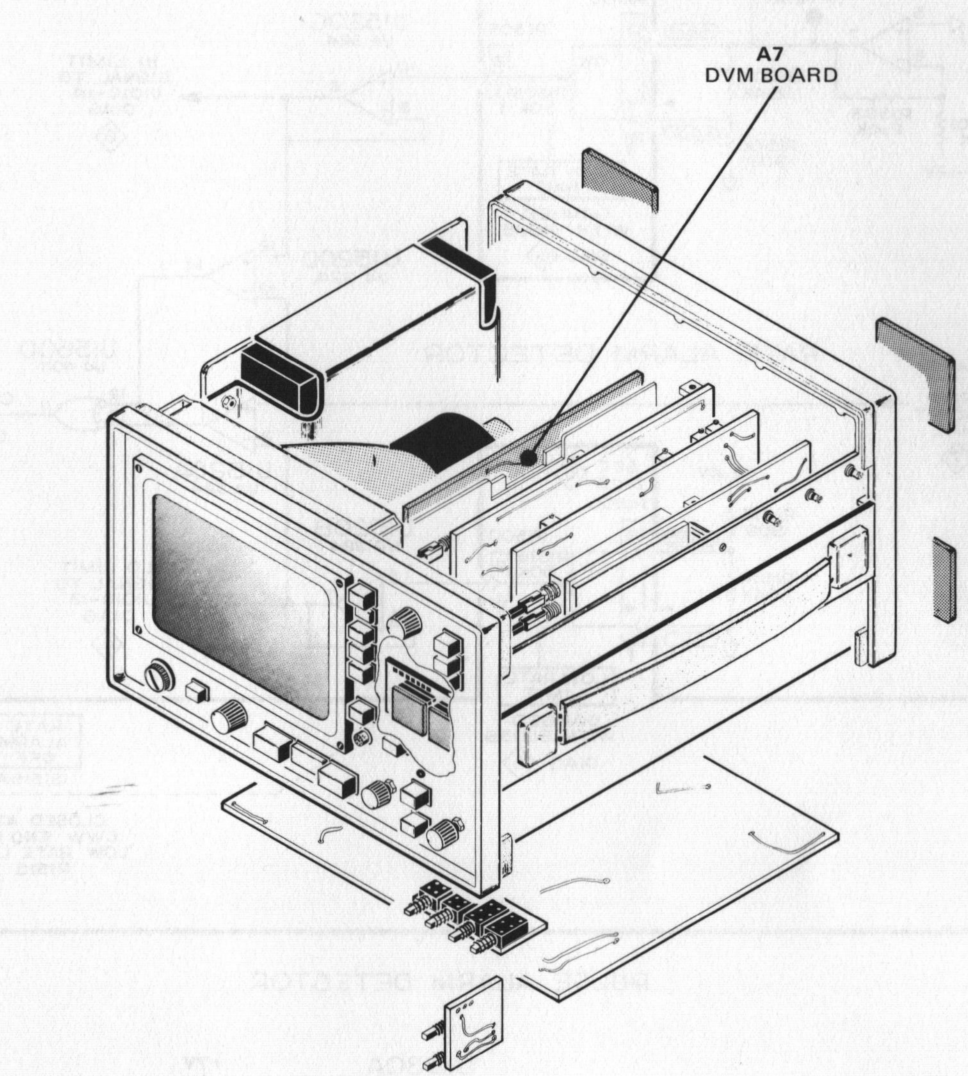


Fig. 8-16. A7—Digital Voltmeter board component locations.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C2307	5D	CR2397	2D	Q2375	1D	R2342	3D	R2379	2D	TPGND	3E	U2390	3E
C2309	1D	CR2399	3E	Q2376	1C	R2343	3D	R2380	2D	TP+5V	4C	U2395	2E
C2332	3C			Q2378	1B	R2344	3D	R2382	3D	TP+75V	3E	U2397	1E
C2335	3C	P2300	1E			R2346	4D	R2384	3E	TP+165V	4B		
C2336	3C	P2350	2F			R2347	4D	R2386	4E	TP–90V	4B	VR2302	4F
C2337	4F	P2355	2F	R2301	4F	R2348	4C	R2388	3E				
C2353	1B			R2302	4D	R2349	4D	R2389	2E	U2302	5F		
C2378	2D	Q2308	5D	R2303	4F	R2352	1E	R2392	5B	U2305	5D		
C2382	2E	Q2341	4D	R2304	5D	R2353	2B	R2393	3E	U2310	2C		
C2390	4C	Q2342	4D	R2305	5E	R2354	1B	R2396	2E	U2315	2B		
C2392	4B	Q2343	4D	R2306	5E	R2356	1C	R2397	2E	U2320	2C		
C2393	4B	Q2344	4D	R2309	2D	R2357	1B	R2398	3E	U2330	3C		
C2396	5C	Q2345	4D	R2311	1C	R2359	1C	R2399	3E	U2335	2C		
		Q2346	3D	R2312	3D	R2361	2E			U2340	4C		
CR2309	5E	Q2347	3D	R2314	3D	R2362	2E			U2345	2A		
CR2334	3C	Q2348	3D	R2317	3C	R2364	1E	T2301	4B	U2350	5C		
CR2340	4C	Q2351	4E	R2319	3C	R2365	1E			U2352	4E		
CR2373	4D	Q2352	4E	R2331	1E	R2368	4F			U2355	2A		
CR2383	4D	Q2353	4E	R2332	1D	R2369	4F	TP2302	1F	U2358	2B		
CR2387	4D	Q2354	3E	R2333	1C	R2370	4C	TP2330	2C	U2360	2D		
CR2388	3E	Q2355	3E	R2334	1C	R2372	4E	TP2335	1B	U2365	1A		
CR2392	3B	Q2356	2E	R2337	1F	R2374	2D	TP2340	1B	U2375	2B		
CR2393	4C	Q2368	2D	R2338	4C	R2375	1D	TP2355	1B	U2380	3B		
CR2395	4C	Q2370	2D	R2340	3D	R2376	2C	TP2365	4C	U2382	3B		
CR2396	5C	Q2373	2D	R2341	4D	R2377	2D	TP2385	4D	U2385	3B		

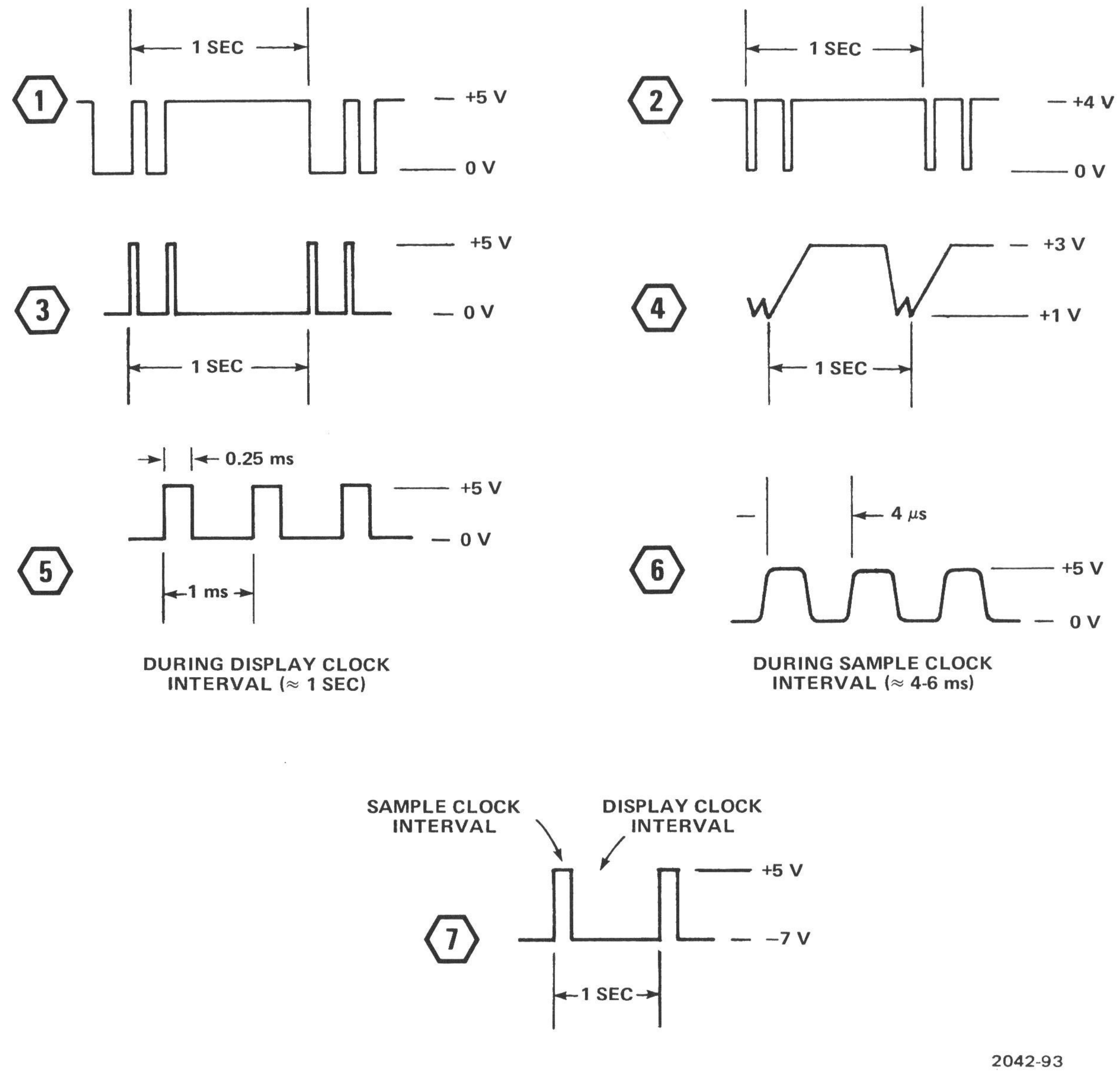
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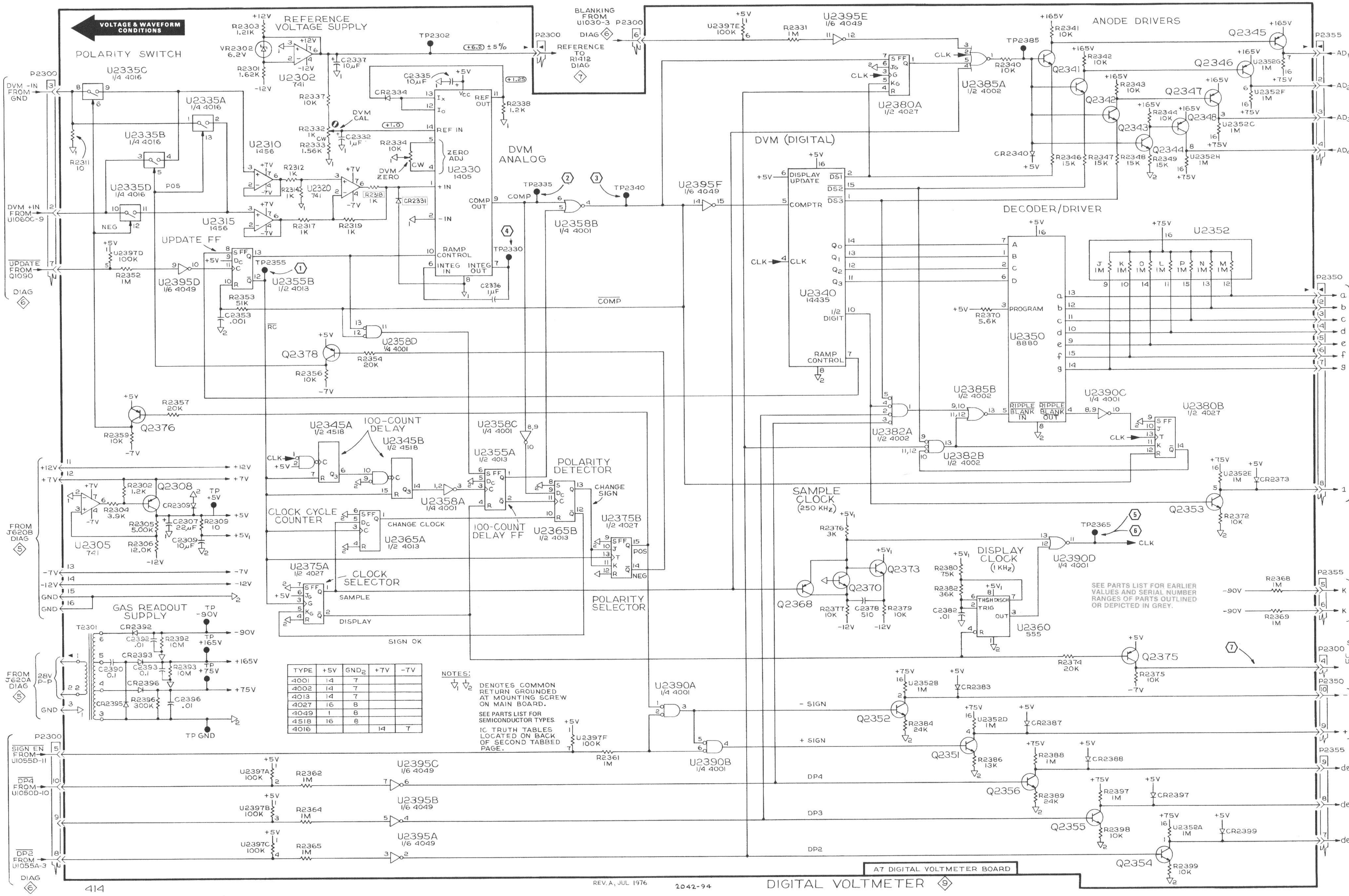


VOLTAGE AND WAVEFORM CONDITIONS

Voltages are design-center values and may vary from measured values. Voltages are referenced to chassis ground at the mounting screw on the Main Board unless noted otherwise.

Waveforms are idealized and may vary from actual test-oscilloscope waveforms.





TYPE	+5V	GND_2	+7V	-7V
4001	14	7		
4002	14	7		
4013	14	7		
4027	16	8		
4049	1	8		
4518	16	8		
4016			14	7

NOTES:

∇_1 ∇_2 DENOTES COMMON RETURN GROUNDED AT MOUNTING SCREW ON MAIN BOARD.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

IC TRUTH TABLES LOCATED ON BACK OF SECOND TABBED PAGE.

REV. A, JUL 1976

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DIGITAL VOLTMETER 9

9

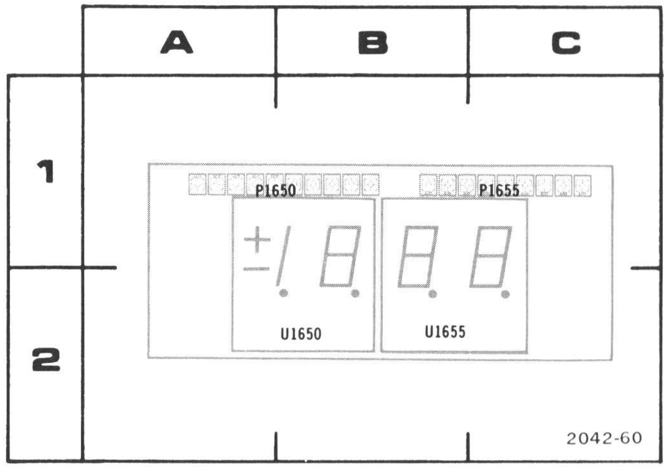
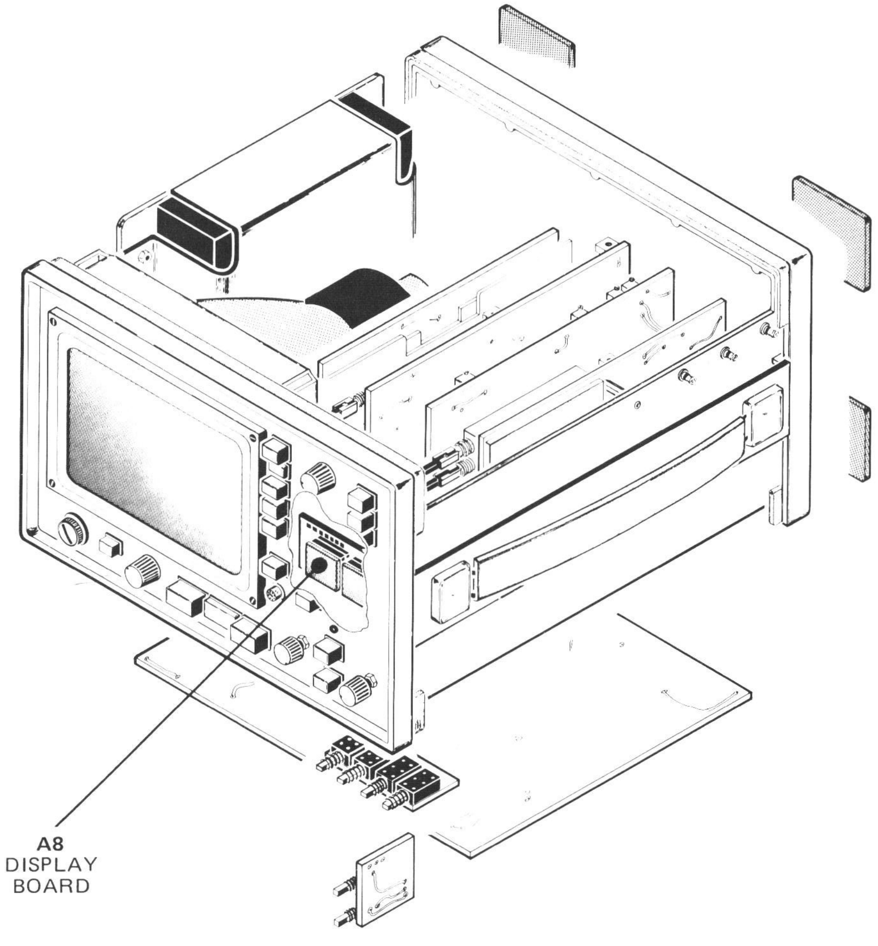
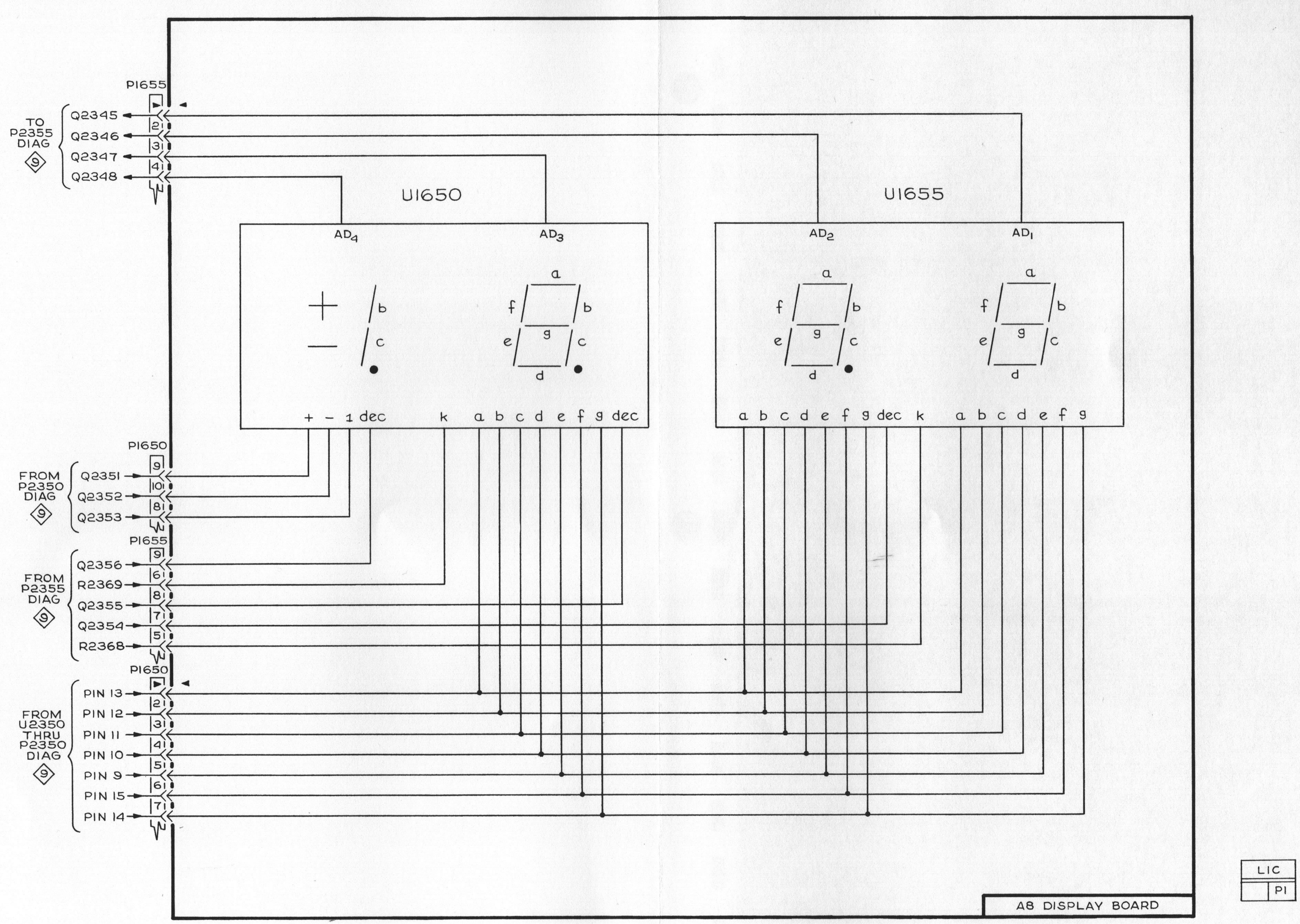


Fig. 8-17. A8—Display board component locations.

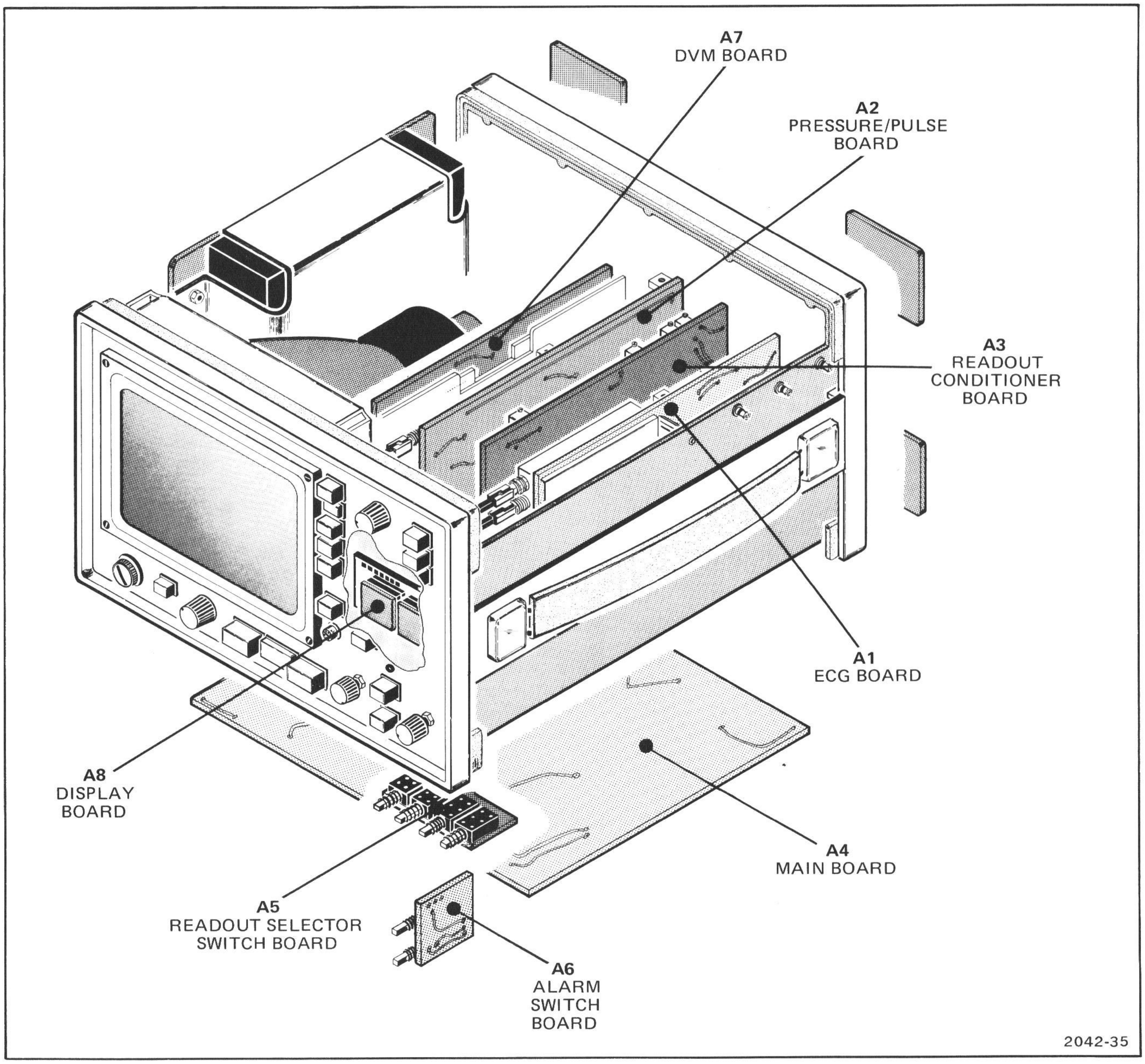
CKT NO	GRID COORD
P1650	1B
P1655	1C
U1650	2B
U1655	2B

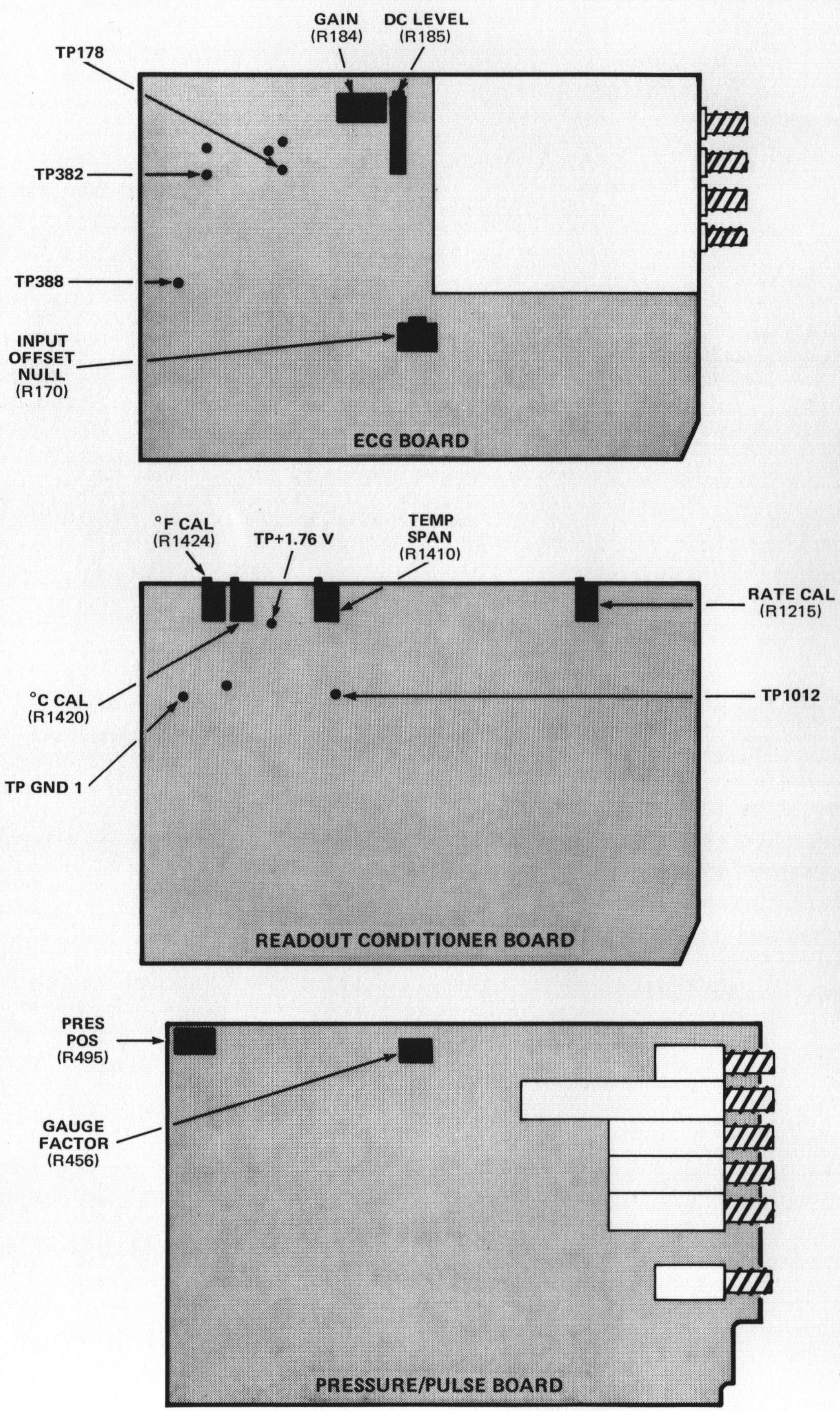
MORE



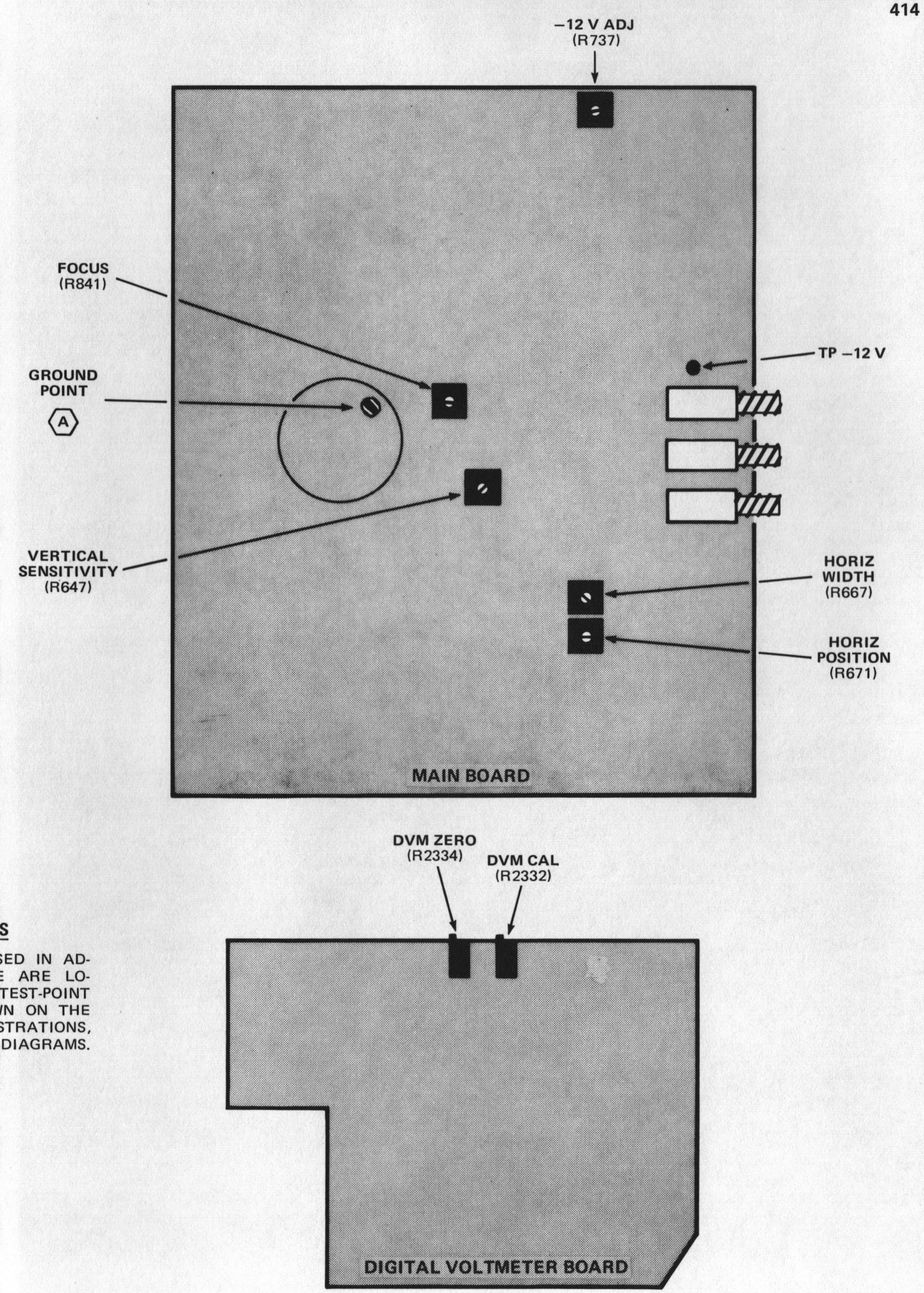


P1655
TO P2355 DIAG 9
Q2345
Q2346
Q2347
Q2348
U1650
U1655
AD4
AD3
AD2
AD1
+ - 1 dec
k
a b c d e f g dec
a b c d e f g dec k
a b c d e f g
P1650
FROM P2350 DIAG 9
Q2351
Q2352
Q2353
FROM P2355 DIAG 9
Q2356
R2369
Q2355
Q2354
R2368
FROM U2350 THRU P2350 DIAG 9
PIN 13
PIN 12
PIN 11
PIN 10
PIN 9
PIN 15
PIN 14
A8 DISPLAY BOARD
LIC
P1


A7
DVM BOARD
A2
PRESSURE/PULSE
BOARD
A3
READOUT
CONDITIONER
BOARD
A1
ECG BOARD
A8
DISPLAY
BOARD
A4
MAIN BOARD
A5
READOUT SELECTOR
SWITCH BOARD
A6
ALARM
SWITCH
BOARD
2042-35



FRONT

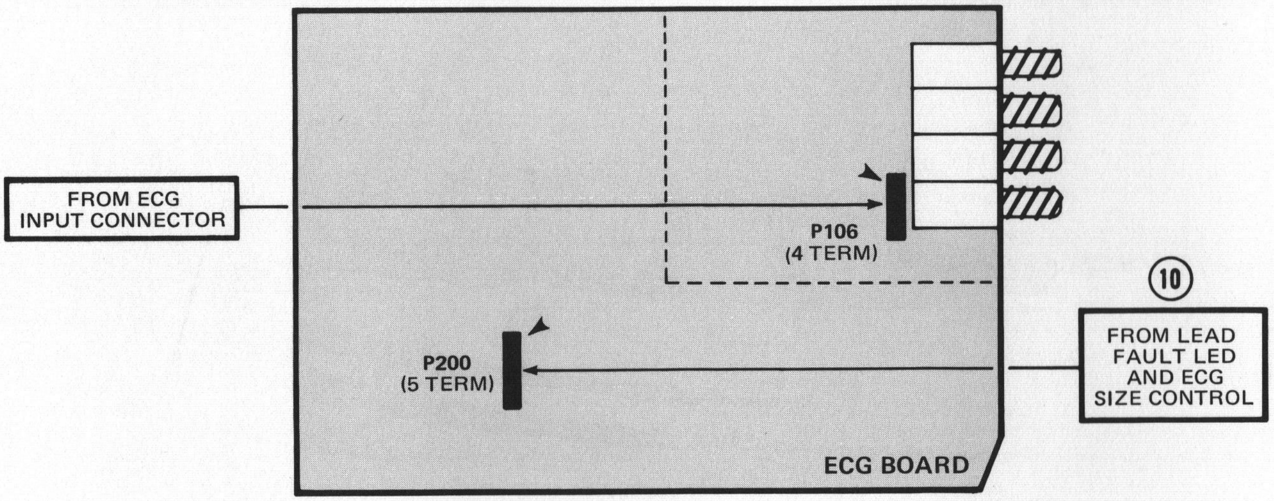


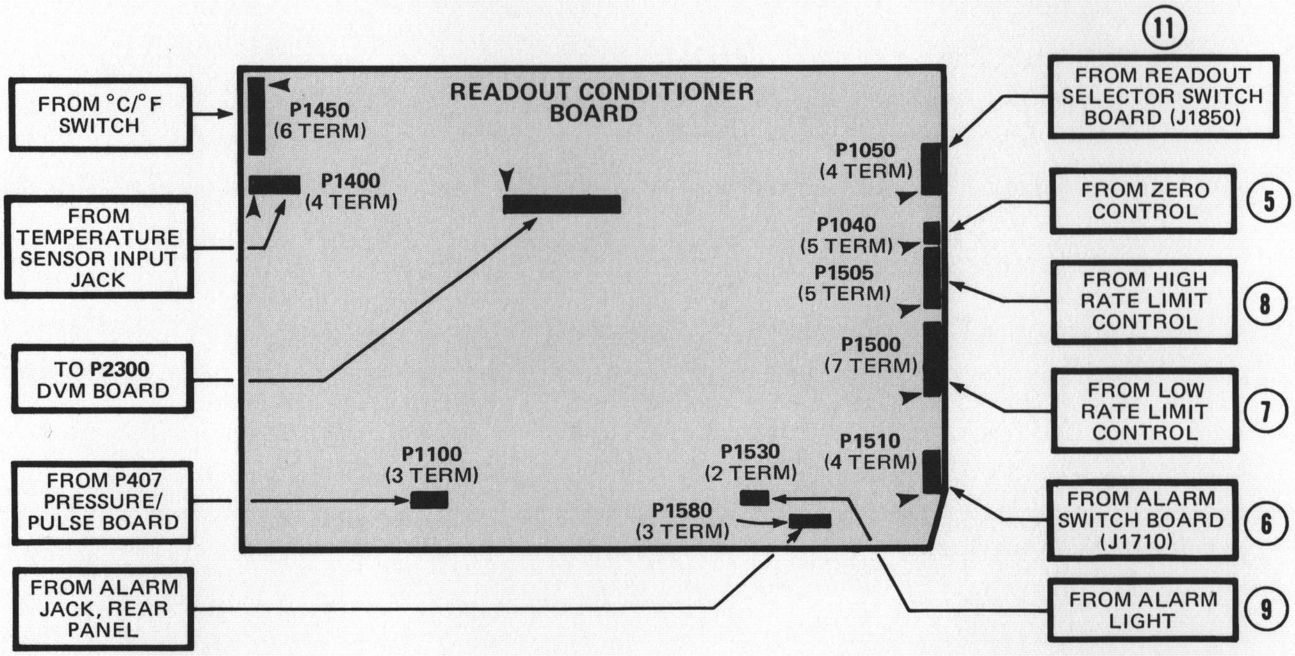
TEST POINTS

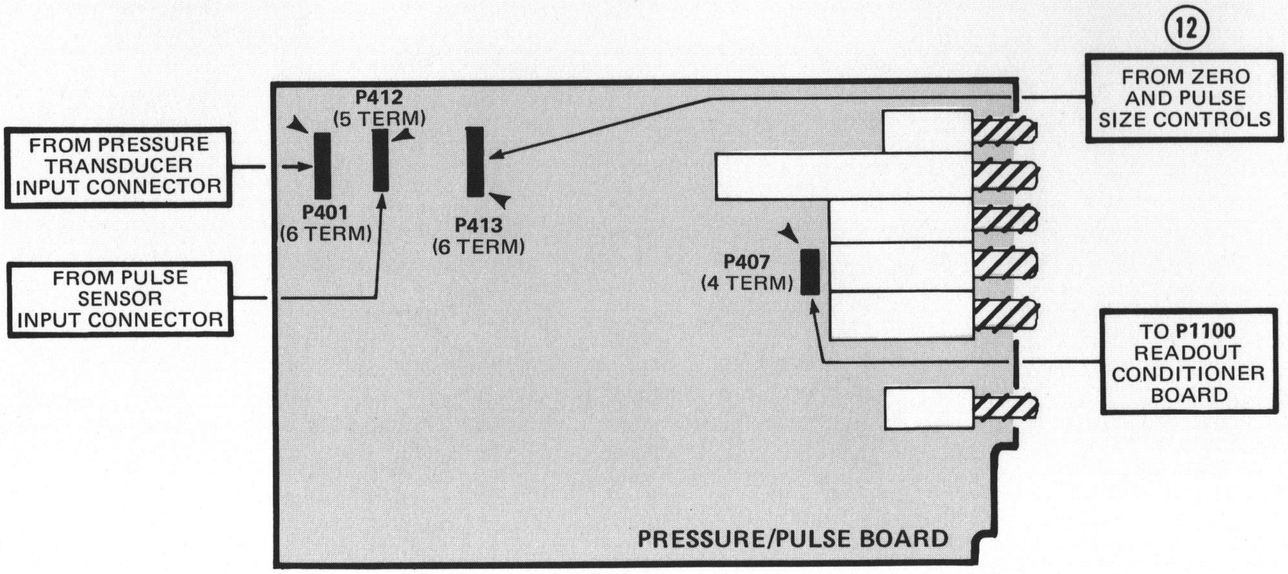
ONLY TEST POINTS USED IN ADJUSTMENT PROCEDURE ARE LOCATED HERE. ALL TEST-POINT LOCATIONS ARE SHOWN ON THE CIRCUIT BOARD ILLUSTRATIONS, OPPOSITE SCHEMATIC DIAGRAMS.

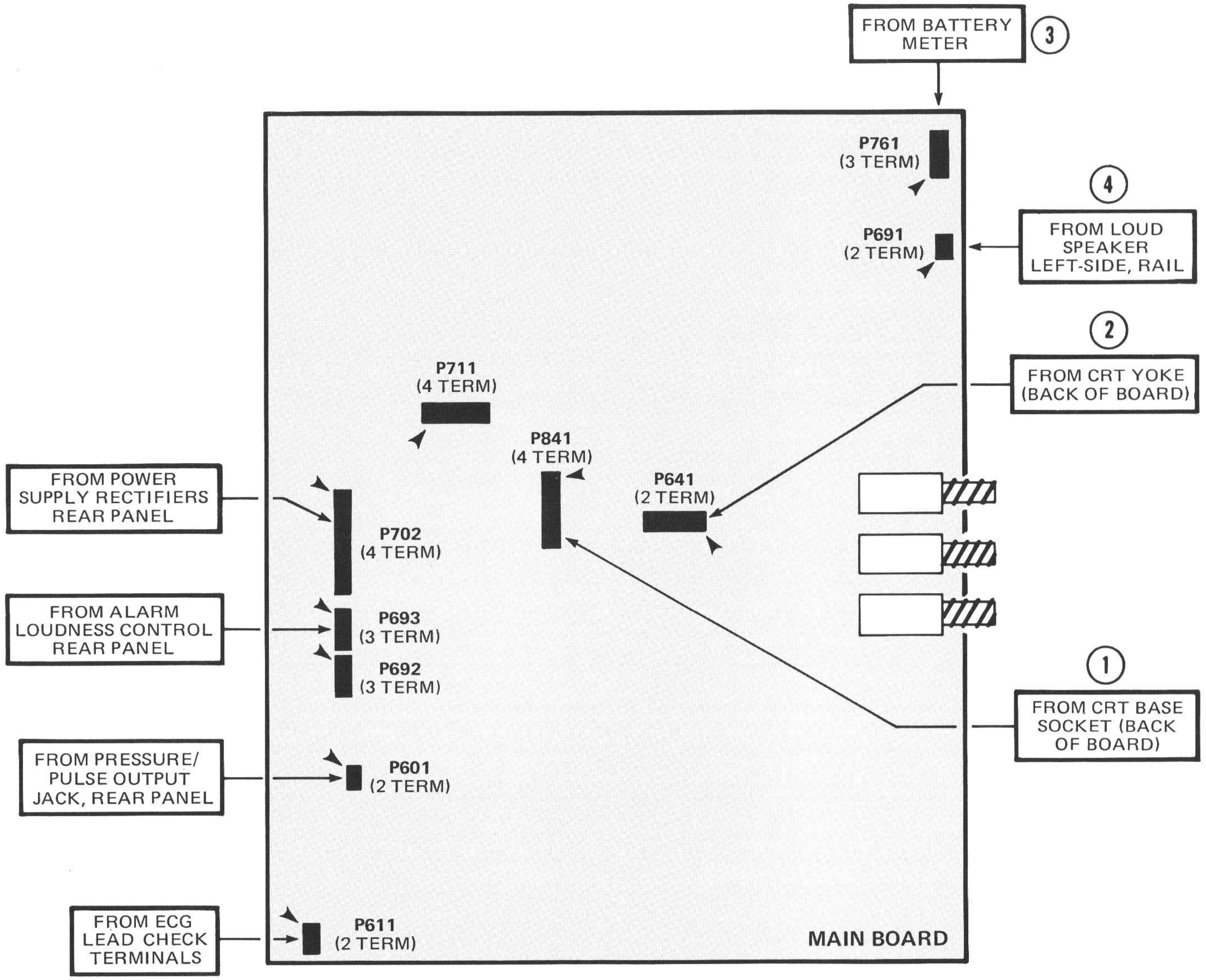
2042-61

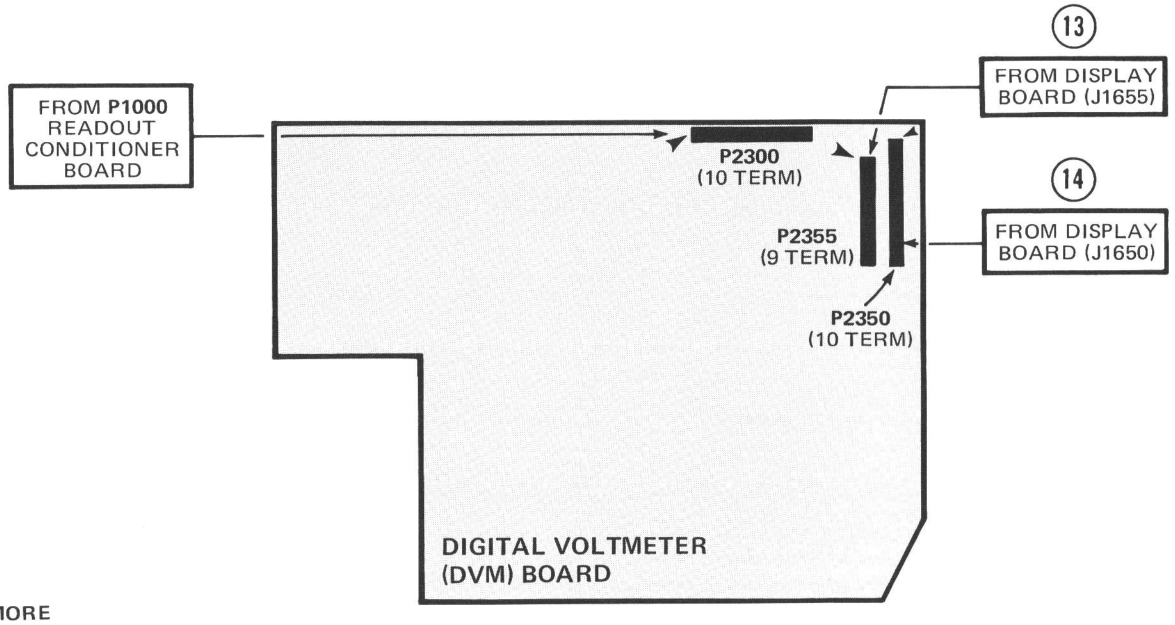
Fig. 8-18. Adjustment and test-point locations.

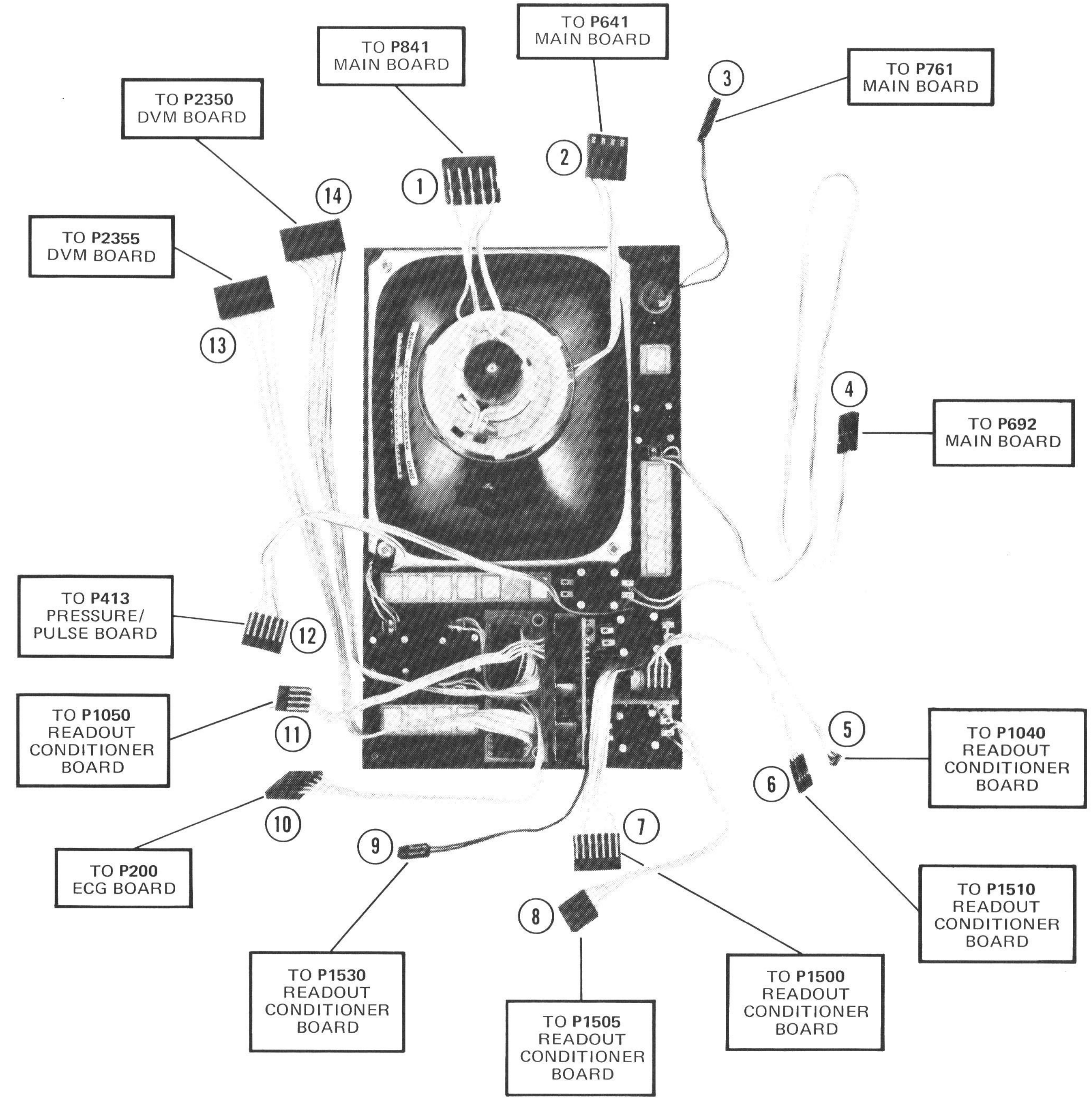

FROM ECG INPUT CONNECTOR
P106 (4 TERM)
10
FROM LEAD FAULT LED AND ECG SIZE CONTROL
P200 (5 TERM)
ECG BOARD


11
FROM READOUT SELECTOR SWITCH BOARD (J1850)
READOUT CONDITIONER BOARD
FROM °C/°F SWITCH
P1450 (6 TERM)
P1400 (4 TERM)
FROM TEMPERATURE SENSOR INPUT JACK
P1050 (4 TERM)
FROM ZERO CONTROL
5
P1040 (5 TERM)
P1505 (5 TERM)
FROM HIGH RATE LIMIT CONTROL
8
TO P2300 DVM BOARD
P1500 (7 TERM)
FROM LOW RATE LIMIT CONTROL
7
P1100 (3 TERM)
P1530 (2 TERM)
P1510 (4 TERM)
FROM P407 PRESSURE/ PULSE BOARD
P1580 (3 TERM)
FROM ALARM SWITCH BOARD (J1710)
6
FROM ALARM JACK, REAR PANEL
FROM ALARM LIGHT
9


12
FROM ZERO AND PULSE SIZE CONTROLS
P412 (5 TERM)
FROM PRESSURE TRANSDUCER INPUT CONNECTOR
P401 (6 TERM)
P413 (6 TERM)
P407 (4 TERM)
FROM PULSE SENSOR INPUT CONNECTOR
TO P1100 READOUT CONDITIONER BOARD
PRESSURE/PULSE BOARD







FRONT-PANEL ASSEMBLY REMOVED.

NOTES

1. CIRCLED NUMBERS REFER TO FRONT-PANEL ASSEMBLY CONNECTIONS.
2. MATCH TRIANGLES ON CABLE PLUGS WITH TRIANGLES ON BOARD.

MORE

Fig. 8-19. Cable interconnections.

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REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

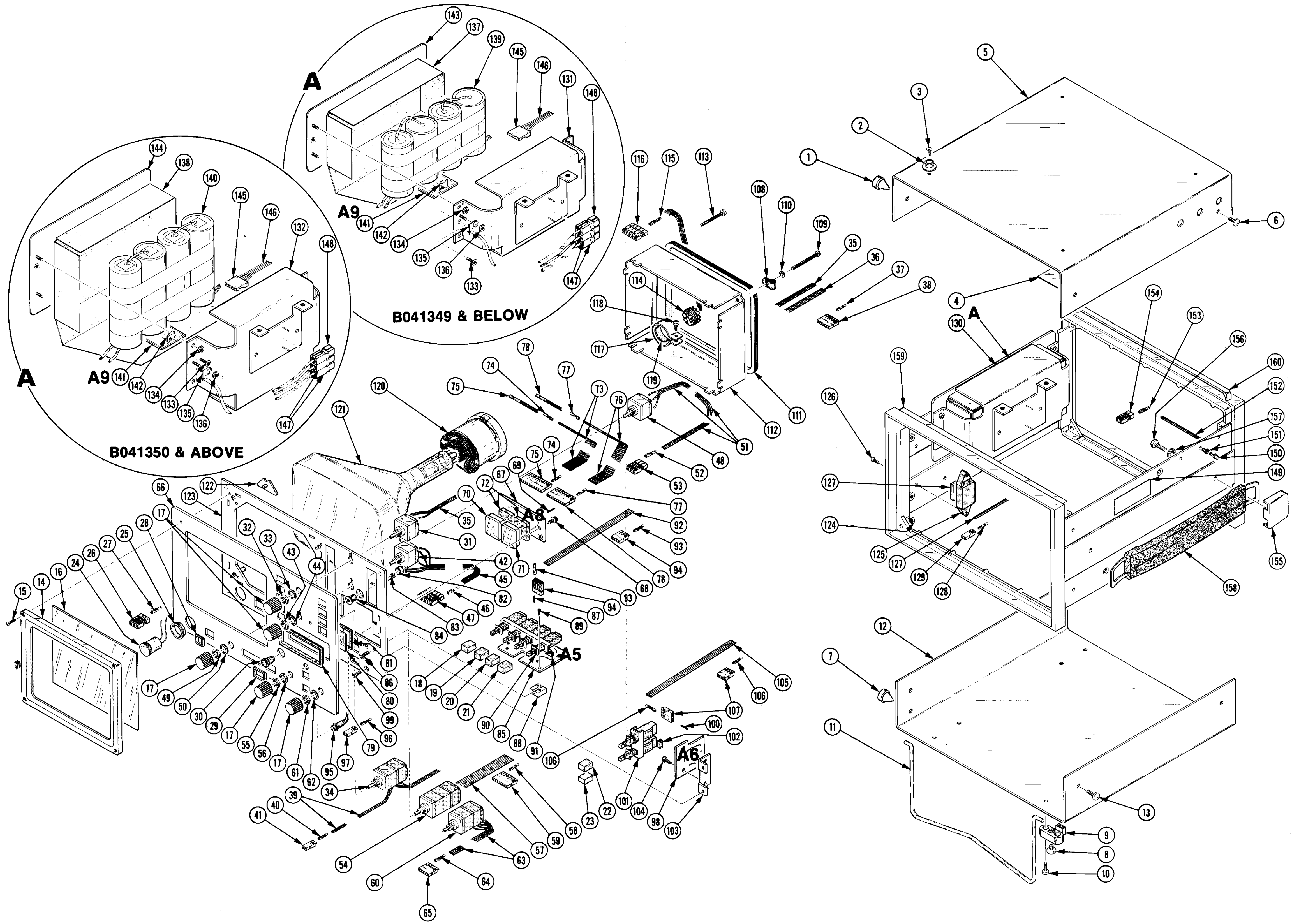
Mfr. Code	Manufacturer	Address	City, State, Zip
000CP	AIMSCO	4024 22ND AVE. WEST	SEATTLE, WA 98199
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
000EB	AIR-O-PLASTIK	150 FIELDCREST AVENUE	EDISON, NJ 08817
000EL	PORTLAND SCREW CO.	6520 N. BASIN AVE.	PORTLAND, OR 97217
000FB	CALIFORNIA EASTERN LABORATORIES	3005 DEMOCRACY WAY	SANTA CLARA, CA 95050
0000M	SONY/TEKTRONIX CORPORATION	P O BOX 14, HANEDA AIRPORT	TOKYO 149, JAPAN
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02288	GOULD INC., ALLIED CONTROL DIVISION	100 RELAY ROAD	PLANTSVILLE, CT 06479
02318	AMERICAN HOSPITAL SUPPLY CORPORATION	1740 RIDGE AVENUE	EVANSTON, IL 60204
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
02929	NEWARK ELECTRONICS CORPORATION	500 N PULASKI ROAD	CHICAGO, IL 60624
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12136	PHILADELPHIA HANDLE COMPANY, INC.	1643 HADDON AVENUE	CAMDEN, NJ 08103
12360	ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORPORATION	145 WOODWARD AVENUE	SOUTH NORWALK, CT 06586
16428	BELDEN CORP.	P. O. BOX 1331	RICHMOND, IN 47374
19209	GENERAL ELECTRIC CO., ELECTRONIC CAPACITOR AND BATTERY PRODUCTS DEPT. BATTERY PRODUCTS SEC.	P. O. BOX 114	GAINESVILLE, FL 32601
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22670	G.M. NAMEPLATE, INC.	2040 15TH AVENUE WEST	SEATTLE, WA 98119
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
52536	BECKMAN INSTRUMENTS, INC., INFORMATION DISPLAYS OPERATION	350 N. HAYDEN ROAD	SCOTTSDALE, AZ 85257
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71279	CAMBRIDGE THERMIONIC CORP.	445 CONCORD AVE.	CAMBRIDGE, MA 02138
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74545	HUBBELL HARVEY, INC.	584 DERBY MILFORD ROAD	ORANGE, CT 06477
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77132	DOT FASTENER CO., A UNITED-CARR DIV. OF TRW INC.	ROUND HOUSE INDL PK,PO BOX 710	WATERBURY, CT 06720
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77342	AMF INC., POTTER AND BRUMFIELD DIV.	200 RICHLAND CREEK DRIVE	PRINCETON, IN 47670
77969	RUBBERCRAFT CORP. OF CALIF., LTD.	1800 W. 220TH ST.	TORRANCE, CA 90507
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81312	WINCHESTER ELECTRONICS DIVISION LITTON INDUSTRIES, INC.	MAIN ST. AND HILLSIDE AVE.	OAKVILLE, CT 06779
82104	STANDARD GRIGSBY CO., DIV. OF SUN CHEMICAL CORPORATION	920 RATHBONE AVENUE	AURORA, IL 60507
83309	ELECTRICAL SPECIALITY CO., SUBSIDIARY OF BELDEN CORP.	213 E. HARRIS AVE. SOUTH	SAN FRANCISCO, CA 94080
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	348-0414-00			2	BUMPER,PLASTIC:0.500 DIA,TEK BLUE	80009	348-0414-00
-2	355-0184-00			4	STUD,SNAP FSTNR:	77132	BS-10370
					(ATTACHING PARTS)		
-3	211-0105-00			4	SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-4	342-0142-00			2	INSULATOR,FILM:HV XFMR,MYLAR	0000M	342-0142-00
-5	390-0364-01	B010100	B084323	1	COVER,MONITOR:TOP	80009	390-0364-01
	390-0364-02	B084324		1	CAB.,WRAPAROUND:TOP	80009	390-0364-02
					(ATTACHING PARTS)		
-6	211-0565-00			4	SCREW,MACHINE:6-32 X 0.250 INCH,TRH STL	83385	OBD
					- - - * - - -		
-7	348-0414-00			2	BUMPER,PLASTIC:0.500 DIA,TEK BLUE	80009	348-0414-00
-8	348-0089-00			4	BUMPER,PLASTIC:BLACK VINYL	80009	348-0089-00
-9	348-0380-01			4	FOOT,CABINET:TEK BLUE NYLON	80009	348-0380-01
					(ATTACHING PARTS)		
-10	211-0097-00			8	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-11	348-0282-00			1	FLIPSTAND,CAB.:3.438 H,SST	80009	348-0282-00
-12	390-0363-00	B010100	B085868	1	COVER,MONITOR:BOTTOM	80009	390-0363-00
	390-0363-03	B085869		1	COVER,MONITOR:BOTTOM	80009	390-0363-03
					(ATTACHING PARTS)		
-13	211-0565-00			4	SCREW,MACHINE:6-32 X 0.250 INCH,TRH STL	83385	OBD
					- - - * - - -		
-14	200-1547-01			1	RTNR,CRT SCALE:4.95 X 3.95 X0.18 NYLON	80009	200-1547-01
					(ATTACHING PARTS)		
-15	211-0646-00			4	SCREW MACHINE:2-56 X 0.375 INCH,PNH,STL	12360	OBD
					- - - * - - -		
-16	337-2310-01			1	SHLD,IMPLOSION:	80009	337-2310-01
-17	366-1495-01			5	KNOB:SIL GY,0.127 ID X 0.5 OD X 0.438 H	80009	366-1495-01
	213-0153-00			5	. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-18	366-1557-47			1	PUSH BUTTON:SIL GY,SYST-DIAST	80009	366-1557-47
-19	366-1402-91			1	PUSH BUTTON:SIL GY,MEAN	80009	366-1402-91
-20	366-1557-45			1	PUSH BUTTON:SIL GY,RATE	80009	366-1557-45
-21	366-1557-44			1	PUSH BUTTON:SIL GY,TEMP	80009	366-1557-44
-22	366-1489-23			1	PUSH BUTTON:GRAY--RESET	80009	366-1489-23
-23	366-1557-43			1	PUSH BUTTON:SIL GY,PULSE ALARM	80009	366-1557-43
-24	149-0031-03	B010100	B029999	1	METER,BTRY LVL:0-200VA,+/-15%	80009	149-0031-03
	149-0043-01	B030000		1	METER,BAT LEVEL:W/BRACKET,HOLDER AND CONN	80009	149-0043-01
-25	352-0243-01	B010100	B029999X	1	. HOLDER,IND:BATTERY LEVEL,SIL GRAY PP	80009	352-0243-01
-26	352-0199-00			1	. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-27	131-0621-00			2	. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-28	426-0681-00	B010100	B030949	17	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
	426-0681-00	B030950		18	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-29	426-0568-00			3	FR,PUSHBUTTON:PANEL MOUNT	80009	426-0568-00
-30	366-0261-01	B010100	B086009	1	KNOB:SIL GY,0.125 ID X 0.312 OD X0.406 H	80009	366-0261-01
	366-0261-03	B086010		1	KNOB:SIL GY,0.129 ID X 0.312 OD	80009	366-0261-03
	214-0949-00			1	. SPR,HLCL,TRSN:0.282" OD X 0.125" LONG	80009	214-0949-00
-31	----- -----			1	RES.,VAR:SIZE(SEE R417 REPL)		
					(ATTACHING PARTS)		
-32	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-33	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-34	----- -----			1	RES.,VAR:ZERO/READOUT(SEE R413/S413 REPL)		
					(ATTACHING PARTS)		
	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					- - - * - - -		
-35	175-0826-00	B010100	B062970	FT	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	175-0076-00	B062971		FT	CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
-36	175-0826-00	B010100	B062970	FT	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	175-0076-00	B062971		FT	CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
-37	131-0707-00			6	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-38	352-0164-00			1	CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
-39	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-40	131-0707-00			2	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-41	352-0169-00			1	HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-42	----- -----			1	RES.,VAR:SIZE(SEE R195 REPL)		
					(ATTACHING PARTS)		
-43	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-44	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-45	175-0828-00	B010100	B062970	FT	WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
	175-1166-00	B062971		FT	CABLE,SP,ELEC:5,26 AWG,STRD,BRAIDED SHLD	80009	175-1166-00
-46	131-0621-00			5	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-47	352-0201-00			1	CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-48	----- -----			1	RES.,VAR:BEAT LOUDNESS(SEE R692 REPL)		
					(ATTACHING PARTS)		
-49	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-50	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-51	175-0826-00	B010100	B062970	FT	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	175-0076-00	B062971		FT	CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
-52	131-0621-00			3	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-53	352-0199-00			1	CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-54	----- -----			1	RES.,VAR:LOW RATE(SEE R1515/S1515A,B REPL)		
					(ATTACHING PARTS)		
-55	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-56	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-57	175-0830-00			FT	WIRE,ELECTRICAL:7 WIRE RIBBON	08261	SS-0726-710610C
-58	131-0707-00			7	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-59	352-0165-00			1	CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0165-00
-60	----- -----			1	RES.,VAR:HIGH RATE(SEE R1505/S1505 REPL)		
					(ATTACHING PARTS)		
-61	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-62	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-63	175-0828-00	B010100	B062970	FT	WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
	175-1166-00	B062971		FT	CABLE,SP,ELEC:5,26 AWG,STRD,BRAIDED SHLD	80009	175-1166-00
-64	131-0707-00			5	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-65	352-0163-00			1	CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
-66	333-2142-00	B010100	B029999	1	PANEL,FRONT:	80009	333-2142-00
	333-2142-01	B030000		1	PANEL,FRONT:	80009	333-2142-01
					(ATTACHING PARTS)		
	210-0586-00	XB050000		4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
	211-0198-00	XB050000		4	SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	OBD
					- - - * - - -		
-67	----- -----			1	CKT BOARD ASSY:DISPLAY(SEE A8 REPL)		
					(ATTACHING PARTS)		
-68	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-69	131-0589-00			19	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-70	----- -----			1	. IND,DGTL DSPLY:NEON(SEE U1650 REPL)		
-71	----- -----			1	. LAMP,GLOW,RDOUT:NEON(SEE U1655 REPL)		
-72	136-0565-01			2	. SKT,PL-IN ELEK:READOUT TUBE	52536	CS-332
-73	175-0833-00			FT	WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
-74	131-0707-00			20	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-75	352-0168-00			2	CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-76	175-0832-00			FT	WIRE,ELECTRICAL:9 WIRE RIBBON	08261	SS-0926(1061)0C
-77	131-0707-00			18	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-78	352-0167-00			2	HLDR,TERM CONN:9 WIRE BLACK	80009	352-0167-00
-79	426-0916-01			1	FRAME,RDOUT WDO:	80009	426-0961-01
-80	378-0080-00			1	FILTER,LIGHT:0.6W X 2.133" L,AMBER	80009	378-0080-00
-81	331-0411-00			1	MASK,READOUT:	80009	331-0411-00
-82	200-0935-00			1	BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-83	----- -----			1	LAMP,LED:LEAD FAULT(SEE DS213 REPL)		
-84	352-0157-00			1	LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-85	----- -----			1	CKT BOARD ASSY:READOUT SW(SEE A5 REPL)		
					(ATTACHING PARTS)		
-86	211-0541-00			2	SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-87	131-0608-00			4	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-88	352-0239-00			2	. LAMPHOLDER:(1)WIRE LEAD TYPE	80009	352-0239-00
					(ATTACHING PARTS)		
-89	211-0186-00			4	. SCREW,MACHINE:0-80 X 0.125,FILH,SST,SLOT	12360	00A008AHBUU01
					- - - * - - -		
-90	----- -----			1	. SWITCH,PUSH:READOUT SELECTOR(SEE S1850 REPL)		
-91	361-0542-00			6	. SPACER,SWITCH:PLASTIC	71590	J-64281
-92	175-0827-00			FT	CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-93	131-0707-00			8	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-94	352-0162-00			2	HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-95	----- -----			1	LAMP,CARTRIDGE:ALARM(SEE DS1585 REPL)		
-96	131-0707-00			2	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-97	352-0169-00			1	HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-98	----- -----			1	CKT BOARD ASSY:ALARM SWITCH(SEE A6 REPL)		
					(ATTACHING PARTS)		
-99	213-0107-00			2	SCR,TPG,THD FOR:4-40 X 0.25 INCH,FLH STL	93907	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-100	131-0608-00			4	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-101	----- -----			1	. SWITCH,PUSH:RESET/ALARM(SEE S1715/S1710 REPL)		
-102	361-0542-00			4	. SPACER,SWITCH:PLASTIC	71590	J-64281
-103	407-1793-00			1	. BRKT,ALARM SW:CIRCUIT BOARD,ALUMINUM	80009	407-1793-00
					(ATTACHING PARTS)		
-104	213-0088-00			2	. SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-105	175-0827-00			FT	CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-106	131-0707-00			8	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-107	352-0162-00			2	HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-108	343-0144-00			2	CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
					(ATTACHING PARTS)		
-109	211-0021-00			2	SCREW,MACHINE:4-40 X 1.25 INCH,PNH STL	83385	OBD
-110	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					- - - * - - -		
-111	252-0571-00			FT	NEOPRENE EXTR:CHAN,0.234 X 0.156	77969	1353
-112	343-0427-00			1	RTNR,ELCTRN TUB:FRONT	80009	343-0427-00
					(ATTACHING PARTS)		
-113	211-0021-00			2	SCREW,MACHINE:4-40 X 1.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
	136-0551-00	B010100	B073099	1	SOCKET,PLUG-IN:CRT	80009	136-0551-00
	136-0551-01	B073100	B079999	1	SKT,PL-IN ELEK:CRT,11 CONT W/LEADS	80009	136-0551-01
	136-0551-03	B080000		1	SKT,PL-IN ELEK:ELCTRN TUBE,11 CONT,W/LEAD	80009	136-0551-03
-114	136-0551-00			1	. SOCKET,PLUG-IN:CRT	80009	136-0551-00
-115	131-0621-00			5	. . CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-116	352-0201-00	B010100	B079999	1	. . CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
	352-0201-04	B080000		1	. . HLDR,TERM CONN:5 WIRE YELLOW	80009	352-0201-04
-117	343-0428-00			1	CLAMP,LOOP:0.85 DIAL	80009	343-0428-00
					(ATTACHING PARTS)		
-118	211-0097-00			1	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-119	343-0429-01			2	CUSHION,CRT:REAR,URETHANESPONGE	80009	343-0429-01
-120	----- -----			1	COIL,TUBE DEFL:(SEE L840 REPL)		
	131-0621-00			4	. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	352-0200-00			1	. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-121	----- -----			1	ELECTRON TUBE:CRT(SEE V840 REPL)		
-122	348-0352-00			4	PAD,CUSHIONING:CRT,FRONT CORNER	80009	348-0352-00
-123	386-3513-00	B010100	B029999	1	SUBPANEL,FRONT:	80009	386-3513-00
	386-3513-01	B030000		1	SUBPANEL,FRONT:	80009	386-3513-01
					(ATTACHING PARTS)		
-124	210-0586-00			4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
					- - - * - - -		
-125	352-0449-00			1	HOLDER,SPEAKER:TELEQUIPMENT	80009	352-0449-00
					(ATTACHING PARTS)		
-126	211-0101-00			2	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	210-0202-00	XB041350		1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-127	----- -----			1	LOUDSPEAKER,PM:W/CABLE(SEE LS691 REPL)		
-128	131-0707-00			2	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-129	352-0169-00	B010100	B089999	1	. HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
	352-0169-05	B090000		1	. CONN BODY,PL,EL:2 WIRE GREEN	80009	352-0169-05
	334-2128-00	XB080000		1	MARKER,IDENT:MKD CHARGE RATE WARNING	80009	334-2128-00
-130	----- -----			1	BATTERY SET:(SEE BT714 REPL)		
-131	380-0329-00	B010100	B041349	1	. HOUSING,BATTERY:ALUMINUM	80009	380-0329-00
	380-0329-02	B041350	B079999X	1	. HOUSING,BATTERY:W/BRACKET	80009	380-0329-02
-132	380-0345-00	B010100	B041349	1	. HSG,BATTERY SET:ALUMINUM	80009	380-0345-00
	380-0345-02	B041350		1	. HOUSING,BATTERY:W/BRACKET,ALUMINUM	80009	380-0345-02
					(ATTACHING PARTS)		
-133	211-0101-00			2	. SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-134	210-0586-00			4	. NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
					- - - * - - -		
-135	210-0202-00			1	. TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
					(ATTACHING PARTS)		
-136	210-0407-00			1	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
-137	342-0190-00	B010100	B041349	1	. INSUL,BAT PACK:FISH PAPER	80009	342-0190-00
-138	342-0204-00	B041350		1	. INSUL,BAT PACK:BATTERY PACK,FISH PAPER	80009	342-0204-00
-139	146-0023-00	B010100	B041349	4	. BATTERY,STORAGE:1.25V,3.5AH AT 1 HR	19209	XGCW4.0ST
-140	146-0024-00	B041350		4	. BATTERY,STORAGE:1.2V,7000 MAH	19209	XGCW5.6ST
-141	----- -----			1	. CKT BOARD ASSY:FUSE HOLDER(SEE A9 REPL)		
-142	----- -----			2	. . FUSE,CARTRIDGE:(SEE F713,714 REPL)		
-143	200-1548-00	B010100	B041349	1	. COVER,BAT SET:D CELLS	80009	200-1548-00
	200-1548-01	B041350	B079999X	1	. COVER,BTRY PACK:D CELLS	80009	200-1548-01
-144	200-1570-00	B010100	B041389	1	. COVER,BAT SET:F CELLS	80009	200-1570-00
	200-1570-01	B041350		1	. COVER,BTRY PACK:F CELLS	80009	200-1570-01
	198-3394-00	XB041350		1	. WIRE SET,ELEC:	80009	198-3394-00
	131-0621-00	B010100	B041349	1	. . CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	131-0707-00	B041350		4	. . CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-145	352-0200-00	B010100	B041349	1	. . HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
	204-0646-00	B041350		1	. . CONN BODY,PLUG:4 FEMALE CONTACTS	22526	65486-004
-146	175-0827-00	B010100	B041349	FT	. . CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
	175-0861-00	B041350		FT	. . WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0422-7(1061)
-147	131-1965-00			2	. . CONN,PLUG,ELEC:SNAP CATCH,30A,BLACK	02929	OBD
-148	131-1966-00			1	. . CONN,PLUG,ELEC:SNAP CATCH,30A,RED	02929	OBD
-149	334-2149-00			4	MARKER,IDENT:MKD CAUTION	80009	334-2149-00
-150	131-1371-00			3	TERM,FEEDTHRU:0.487 L X 0.20A DIA,BRASS	80009	131-1371-00
					(ATTACHING PARTS)		
-151	358-0176-00			3	INSULATOR,BSHG:	88245	421472
					- - - * - - -		
-152	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-153	131-0621-00			2	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-154	352-0198-00			1	HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-155	344-0098-00			2	CLIP,DECORATIVE:CARRYING HANDLE,STL NP	12136	OBD
					(ATTACHING PARTS)		
-156	213-0089-00			2	SCREW,MACHINE:10-32 X 0.375,HEX HD,STL CD	000EL	OBD
-157	210-0010-00			2	WASHER,LOCK:INT,0.20 ID X0.376" OD,STL	78189	1210-00-00-0541C
					- - - * - - -		
-158	367-0037-00			1	HANDLE,CARRYING:	80009	367-0037-00
-159	426-1034-00	B010100	B041979	1	FRAME ASSY,CAB.:	80009	426-1034-00
	426-1034-01	B041980	B085244X	1	FRAME ASSY,CAB.:	80009	426-1034-01
	426-0997-01	B010100	B041979	1	. FRAME SECT,CAB.:FRONT & REAR	80009	426-0997-01
	426-0997-02	B041980	B085244	1	. FRAME SECT,CAB.:FRONT AND REAR	80009	426-0997-02
	426-0997-03	B085245		1	. FRAME SECT,CAB.:FRONT & REAR	80009	426-0997-03
	426-1032-00	B010100	B041979	1	. FRAME SECT,CAB.:RIGHT	80009	426-1032-00
	426-1032-01	B041980	B085244	1	. FRAME SECT,CAB.:RIGHT	80009	426-1032-01
	426-1032-02	B085245		1	. FRAME SECT,CAB.:RIGHT	80009	426-1032-02
	426-1033-00	B010100	B041979	1	. FRAME SECT,CAB.:LEFT	80009	426-1033-00
	426-1033-01	B041980	B085244	1	. FRAME SECT,CAB.:LEFT	80009	426-1033-01
	426-1033-02	B085245		1	. FRAME SECT,CAB.:LEFT	80009	426-1033-02
	211-0101-00	XB085245		8	. SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-160	252-0603-00			FT	PLASTIC STRIP:0.25 X 0.125 URETHANE FOAM	000EB	OBD
	334-3379-01	XB074331		1	MARKER,IDENT:MARKED GROUNDSYMBOL	80009	334-3379-01
	334-3380-00	XB084830		2	MARKER,IDENT:MKD STATIC ELEC CAN DAMAGE	22670	OBD


A
A9
B041349 & BELOW
A
A9
B041350 & ABOVE
A8
A5
A6
A

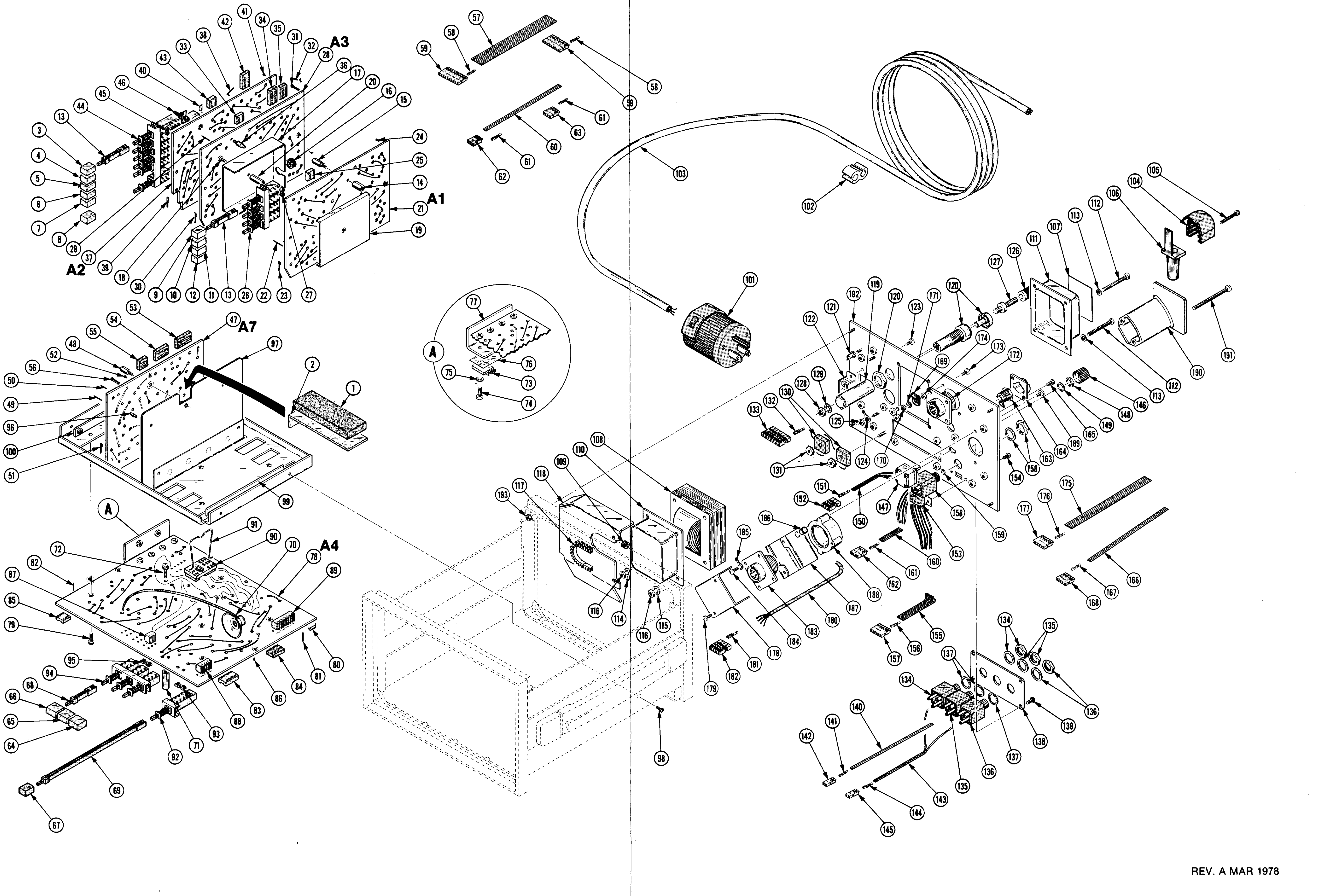

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	348-0362-00	B010100	B052722	1	PAD,CUSHIONING:6.0 X 2.0 X 0.25,FOAM	80009	348-0362-00
	348-0559-00	B052723		1	PAD,CUSHIONING:3.0 X 1.0 X 0.312,NPRN FOAM	80009	348-0559-00
-2	343-0432-00	B010100	B073300	1	RETAINER,CKT BD:POLYCARBONATESIL GRAY	80009	343-0432-00
	343-0432-01	B073301		1	RETAINER,CKT BD:	80009	343-0432-01
-3	366-1557-46			1	PUSH BUTTON:SIL GY,DISPLAY OFF	80009	366-1557-46
-4	366-1402-89			1	PUSH BUTTON:SIL GY,PULSE	80009	366-1402-89
-5	366-1489-25			1	PUSH BUTTON:SIL GY,250	80009	366-1489-25
-6	366-1557-49			1	PUSH BUTTON:SIL GY,5	80009	366-1557-49
-7	366-1402-99			1	PUSH BUTTON:SIL GY,25	80009	366-1402-99
-8	366-1557-48			1	PUSH BUTTON:SIL GY,100MM CHECK	80009	366-1557-48
-9	366-1402-98			1	PUSH BUTTON:OFF	80009	366-1402-98
-9	366-1402-98			1	PUSH BUTTON:OFF	80009	366-1402-98
-10	366-1402-95			1	PUSH BUTTON:SIL GY,I	80009	366-1402-95
-11	366-1402-96			1	PUSH BUTTON:SIL GY,II	80009	366-1402-96
-12	366-1402-97			1	PUSH BUTTON:SIL GY,III	80009	366-1402-97
-13	384-1099-00			10	EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-14	129-0363-00			1	POST,ELEC-MECH:HEX.,0.25 X 0.436 INCH LONG	80009	129-0363-00
					(ATTACHING PARTS)		
-15	129-0613-00			1	SPACER,POST:0.8 L,W/4-40 THD ONE END AL	80009	129-0613-00
	211-0101-00			1	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-16	348-0003-00			1	GROMMET,RUBBER:0.312 INCH DIAMETER	70485	1411B6040
-17	337-1816-00			1	SHIELD,ELEC:ECG FRONT	80009	337-1816-00
					(ATTACHING PARTS)		
-18	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-19	337-1817-00			1	SHIELD,ELEC:ECG REAR	80009	337-1817-00
					(ATTACHING PARTS)		
-20	129-0338-00			1	POST,ELEC-MECH:HEX.,0.188 X 0.64 INCH LONG	80009	129-0338-00
					- - - * - - -		
-21	----- -----			1	CKT BOARD ASSY:ECG(SEE A1 REPL)		
-22	131-0589-00			21	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-23	131-1261-00			11	. CONTACT,ELEC:F-SHAPED	00779	1-380953-0
-24	136-0252-04	B010100	B086152	79	. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
	136-0252-04	B086153		16	. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-25	136-0514-00	B010100	B086779	8	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (STANDARD ONLY)		
	136-0727-00	B086780		8	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0514-00	B010100	B086799	8	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 2 ONLY)		
	136-0727-00	B086800		8	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0514-00	B010100	B086774	8	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 21 ONLY)		
	136-0727-00	B086775		8	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 21 ONLY)		
-26	----- -----			1	. SWITCH,PUSH:ECG(SEE S110 REPL)		
-27	361-0384-00	B010100	B063438	4	. SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0385-00	B063439		4	. SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-28	----- -----			1	CKT BOARD ASSY:READOUT COND(SEE A3 REPL)		
-29	131-0608-00	B010100	B039999	73	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0608-00	B040000	B109999	75	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0608-00	B110000		59	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0993-00	XB040000		1	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-30	131-1261-00			13	. CONTACT,ELEC:F-SHAPED	00779	1-380953-0
-31	214-0579-02	B010100	B109999	8	. TERM,TEST POINT:BRASS	80009	214-0579-02
	214-0579-02	B110000		7	. TERM,TEST POINT:BRASS	80009	214-0579-02
-32	136-0252-07	B010100	B109999X	18	. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-33	136-0514-00	B010100	B086779	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (STANDARD ONLY)		
	136-0727-00	B086780	B109999	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (STANDRD ONLY)		
	136-0727-00	B110000		7	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0514-00	B010100	B086799	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 2 ONLY)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	136-0727-00	B086800	B109999	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0727-00	B110000		7	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0514-00	B010100	B086803	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 4 ONLY)		
	136-0727-00	B086804	B109999	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0727-00	B110000		7	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0514-00	B010100	B086774	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 21 ONLY)		
	136-0727-00	B086775	B109999	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 21 ONLY)		
	136-0727-00	B110000		7	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 21 ONLY)		
-34	136-0260-00	B010100	B086779	5	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-92-008
	----- -----			-	. (STANDRD ONLY)		
	136-0729-00	B086780		5	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0260-00	B010100	B086799	5	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-92-008
	----- -----			-	. (OPTION 2 ONLY)		
	136-0729-00	B086800		5	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0260-00	B010100	B086803	5	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-92-008
	----- -----			-	. (OPTION 4 ONLY)		
	136-0729-00	B086804		5	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0260-00	B010100	B086774	5	. SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-92-008
	----- -----			-	. (OPTION 21 ONLY)		
	136-0729-00	B086775		5	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 21 ONLY)		
-35	136-0269-02	B010100	B086779	15	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (STANDARD ONLY)		
	136-0728-00	B086780		15	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0269-02	B010100	B086799	15	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 2 ONLY)		
	136-0728-00	B086800		15	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0269-02	B010100	B086803	15	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 4 ONLY)		
	136-0728-00	B086804		15	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0269-02	B010100	B086774	15	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 21 ONLY)		
	136-0728-00	B086775		15	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 21 ONLY)		
-36	386-1558-00			1	. SPACER,CKT BD:0.335 H,ACETAL	80009	386-1558-00
-37	----- -----			1	CKT BOARD ASSY:PRESSURE/PULSE(SEE A2 REPL)		
-38	131-0589-00			24	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-39	131-1261-00			13	. CONTACT,ELEC:F-SHAPED	00779	1-380953-0
-40	131-0566-00			1	. BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-41	136-0252-00			15	. SOCKET,PIN TERM:0.145 INCH LONG	00779	2-330808-7
-42	136-0269-02	B010100	B086779	2	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (STANDARD ONLY)		
	136-0269-02	B086780		2	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (STANDARD ONLY)		
	136-0269-02	B010100	B086799	2	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 2 ONLY)		
	136-0728-00	B086800		2	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0269-02	B010100	B086803	2	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 4 ONLY)		
	136-0728-00	B086804		2	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 4 ONLY)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-43	136-0514-00	B010100	B086779	5	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (STANDARD ONLY)		
	136-0727-00	B086780		5	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0514-00	B010100	B086799	5	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 2 ONLY)		
	136-0727-00	B086800		5	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0514-00	B010100	B086803	5	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 4 ONLY)		
	136-0727-00	B086804		5	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 4 ONLY)		
-44	----- -----			1	. SWITCH,PUSH:PRESSURE/PULSE(SEE S405 REPL)		
-45	361-0384-00	B010100	B063438	8	. SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
	361-0385-00	B063439		8	. SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-46	386-1895-00			1	. SUPPORT,CKT BD:CHASSIS MT,PLASTIC	000CP	CBS-4N 1/4
-47	----- -----			1	CKT BOARD ASSY:DIGITAL VOLTMETER(SEE A7 REPL)		
-48	129-0613-00			1	. SPACER,POST:0.8 L,W/4-40 THD ONE END AL	80009	129-0613-00
-49	131-0589-00			19	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-50	131-0608-00			10	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-51	131-1261-00			9	. CONTACT,ELEC:F-SHAPED	00779	1-380953-0
-52	136-0252-04			63	. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-53	136-0260-02	B010100	B086779	8	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (STANDARD ONLY)		
	136-0729-00	B086780	B099999X	8	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0260-02	B010100	B086799	8	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (OPTION 2 ONLY)		
	136-0729-00	B086800	B099999X	8	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0260-02	B010100	B086803	8	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (OPTION 4 ONLY)		
	136-0729-00	B086804	B099999X	8	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0260-02	B010100	B086774	8	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (OPTION 21 ONLY)		
	136-0729-00	B086775	B099999X	8	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 21 ONLY)		
-54	136-0269-02	B010100	B086779	7	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (STANDARD ONLY)		
	136-0728-00	B086780	B099999X	7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0269-02	B010100	B086799	7	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 2 ONLY)		
	136-0728-00	B086800	B099999X	7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0269-02	B010100	B086803	7	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 4 ONLY)		
	136-0728-00	B086804	B099999X	7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. 9OPTION 4 ONLY)		
	136-0269-02	B010100	B086774	7	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 21 ONLY)		
	136-0728-00	B086775	B099999X	7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 21 ONLY)		
-55	136-0514-00	B010100	B086779	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (STANDARD ONLY)		
	136-0727-00	B086780	B099999X	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0514-00	B010100	B086799	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 2 ONLY)		
	136-0727-00	B086800	B099999X	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0514-00	B010100	B086803	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 4 ONLY)		
	136-0727-00	B086804	B099999X	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0514-00	B010100	B086774	6	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 21 ONLY)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	136-0727-00	B086775	B099999X	6	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 21 ONLY)		
-56	214-0579-00	B010100	B099999	12	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	214-0579-00	B100000		8	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	198-4066-00			1	WIRE SET,ELEC:	80009	198-4066-00
-57	175-0833-00			FT	. WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
-58	131-0707-00			20	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-59	352-0168-00			2	. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-60	175-0826-00	B010100	B062970	FT	. WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	175-0076-00	B062971		FT	. CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
-61	131-0707-00			6	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-62	352-0161-00			1	. HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
-63	352-0162-00			1	. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-64	366-1161-52			1	PUSH BUTTON:GRAY--25	80009	366-1161-52
-65	366-1161-53			1	PUSH BUTTON:GRAY--50	80009	366-1161-53
-66	366-1161-54			1	PUSH BUTTON:GRAY--100	80009	366-1161-54
-67	366-1402-93			1	PUSH BUTTON:GRAY--POWER	80009	366-1402-93
-68	384-1099-00			3	EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-69	384-1100-00			1	EXTENSION SHAFT:0.13 SQ X 6.215" LONG,PLSTC	80009	384-1100-00
-70	195-0125-00			1	LEAD,ELECTRICAL:ANODE	000FB	C5-503V-00
-71	385-0014-00			1	SPACER,POST:0.781 L W/4-40 THD THRU,NYLON	80009	385-0014-00
					(ATTACHING PARTS)		
-72	211-0116-00			1	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-73	----- -----			4	TRANSISTORS:(SEE Q714,Q716,Q746,Q748 REPL)		
					(ATTACHING PARTS)		
-74	211-0094-00	B010100	B089999	4	SCREW,MACHINE:4-40 X 0.500,TRH,SST	83385	OBD
	211-0094-00	B090000		2	SCREW,MACHINE:4-40 X 0.500,TRH,SST	83385	OBD
	211-0012-00	XB090000		1	SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
-75	210-0071-00	B010100	B089999	4	WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
	210-0071-00	B090000		2	WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
	210-1178-00	XB090000		1	WSHR,SHOULDERED:FOR MTG TO-220 TRANSISTOR	49671	DF 137A
					- - - * - - -		
-76	342-0194-00	B010100	B089999	2	INSULATOR,PLATE:TRANSISTOR	80009	342-0194-00
	342-0194-00	B090000		1	INSULATOR,PLATE:TRANSISTOR	80009	342-0194-00
	342-0202-00	XB090000		1	INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
-77	214-1867-00			1	HEAT SINK,XSTR:(4)0.203 DIA HOLES,AL	80009	214-1867-00
					(ATTACHING PARTS)		
	211-0038-00			2	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	OBD
					- - - * - - -		
-78	----- -----			1	CKT BOARD ASSY:MAIN(SEE A4 REPL)		
					(ATTACHING PARTS)		
-79	211-0116-00			5	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-80	131-0566-00			1	. BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-81	131-0589-00	B010100	B084760	42	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	131-0589-00	B084761		44	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
	131-0993-00	XB090000		1	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-82	131-0608-00	B010100	B089999	12	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0608-00	B090000		76	. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-83	136-0260-02	B010100	B086779	1	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (STANDARD ONLY)		
	136-0729-00	B086780	B089999	1	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0729-00	B090000		6	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0260-02	B010100	B086799	1	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (OPTION 2 ONLY)		
	136-0729-00	B086800	B089999	1	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0729-00	B090000		6	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0260-02	B010100	B086803	1	. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	----- -----			-	. (OPTION 4 ONLY)		
	136-0729-00	B086804	B089999	1	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 4 ONLY)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	136-0729-00	B090000		6	. SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108
	----- -----			-	. (OPTION 4 ONLY)		
-84	136-0269-02	B010100	B086779	6	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (STANDARD ONLY)		
	136-0728-00	B086780	B089999	6	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0728-00	B090000		7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0269-02	B010100	B086799	6	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 2 ONLY)		
	136-0728-00	B086800	B089999	6	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0728-00	B090000		7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0269-02	B010100	B086803	6	. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-	. (OPTION 4 ONLY)		
	136-0728-00	B086804	B089999	6	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 4 ONLY)		
	136-0728-00	B090000		7	. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
	----- -----			-	. (OPTION 4 ONLY)		
-85	136-0514-00	B010100	B086779	4	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (STANDARD ONLY)		
	136-0727-00	B086780		4	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (STANDARD ONLY)		
	136-0514-00	B010100	B086799	4	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 2 ONLY)		
	136-0727-00	B086800		4	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 2 ONLY)		
	136-0514-00	B010100	B086803	4	. SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	----- -----			-	. (OPTION 4 ONLY)		
	136-0727-00	B086804		4	. SKT,PL-IN ELEK:MICROCKT,8 CONTACT	09922	DILB8P-108
	----- -----			-	. (OPTION 4 ONLY)		
-86	136-0252-07			96	. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-87	136-0658-00			1	. SKT,PL-IN ELEK:CKT BOARD,3 CONTACT	00779	5-38D949-3
-88	136-0558-00			4	. SOCKET,PLUG-IN:6 CONTACT	00779	5-380949-6
-89	136-0559-00			3	. SOCKET,PLUG-IN:10 PIN,FEMALE	00779	6-380949-0
-90	136-0393-00			1	. SOCKET,PLUG-IN:16 PIN	77342	27E710 W/20C250
	214-0579-00	XB090000		7	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	214-3047-00			1	. RTNR,ELEC RELAY:STAINLESS STEEL	77342	20C250
-91	214-0539-00			1	. RTNR,ELEC RELAY:	02288	30040-2
-92	----- -----			1	. SWITCH,PUSH:POWER(SEE S703 REPL)		
-93	361-0411-00			2	. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-94	----- -----			1	. SWITCH,PUSH:SWEEP SPEED(SEE S661 REPL)		
-95	361-0542-00	B010100	B063438	4	. SPACER,SWITCH:PLASTIC	71590	J-64281
	361-0411-00	B063439		4	. SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-96	386-1556-00			2	SUPPORT,CKT BD:0.215 H,ACETAL	80009	386-1556-00
-97	441-1159-02	B010100	B089999	1	CHASSIS,MONITOR:W/SHIELD	80009	441-1159-02
	441-1159-04	B090000		1	CHASSIS,MONITOR:W/SHIELD	80009	441-1159-04
					(ATTACHING PARTS)		
-98	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	OBD
-99	220-0780-00			1	NUT PLATE:4.312 X 0.312X 0.063,(2)4-40	80009	220-0780-00
-100	220-0781-00			1	NUT PLATE:3.125 X 0.312X 0.063,(2)4-40	80009	220-0781-00
					- - - * - - -		
-101	131-1703-00			1	CONN,PLUG,ELEC:PWR,MALE,125V,15A	74545	8215-0
-102	343-0439-00			1	RTNR,CA TO CA:0.269 OD,POLYETH BLACK	80009	343-0439-00
	334-2551-00	XB097236		1	MARKER,IDENT:MKD WARNING POWER PLUG	80009	334-2551-00
	----- -----			-	(STANDARD ONLY)		
	334-2551-00	XB097270		1	MARKER,IDENT:MKD WARNING POWER PLUG	80009	334-2551-00
	----- -----			-	(OPTS 2,4 & 21 ONLY)		
-103	175-1415-01			1	CABLE ASSY,PWR:3,18 AWG,115V,10.0 L	80009	175-1415-01
					(ATTACHING PARTS)		
-104	343-0440-00			1	RTNR,CABLE NIP.:STRAIN RLF,HORIZ MT,NYLON	80009	343-0440-00
-105	211-0018-00			2	SCREW,MACHINE:4-40 X 0.875 PNH,STL	83385	OBD
					- - - * - - -		
-106	200-1561-00			1	CABLE NIP,ELEC:0.375 ID X 1.5 L,BLACK	80009	200-1561-00
-107	334-2124-00			1	MARKER,IDENT:SERIAL NUMBER	80009	334-2124-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-108	----- -----			1	TRANSFORMER:POWER(SEE T701 REPL)		
-109	348-0003-00			2	. GROMMET,RUBBER:0.312 INCH DIAMETER	70485	1411B6040
-110	200-0105-02			1	. COVER,ELEC XFMR:2.188 X 2.625X 0.875,AL	80009	200-0105-02
-111	200-0105-01			1	. COVER,ELEC XFMR:2.188 X 2.625X 0.875,AL	80009	200-0105-01
-112	211-0553-00			4	. SCREW,MACHINE:6-32 X 1.5 INCH,PNH STL	83385	OBD
-113	210-0006-00			4	. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
-114	210-0202-00			1	. TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-115	210-0006-00	B010100	B086864X	3	. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
	----- -----			-	. (STANDARD ONLY)		
	210-0006-00	B010100	B087104X	3	. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
	----- -----			-	. (OPTION 2 ONLY)		
	210-0006-00	B010100	B086879X	3	. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
	----- -----			-	. (OPTION 4 ONLY)		
	210-0006-00	B010100	B086884X	3	. WASHER,LOCK:#6 INTL,0.018THK,STL CD PL	78189	1206-00-00-0541C
	----- -----			-	. (OPTION 21 ONLY)		
-116	210-0407-00	B010100	B086864	4	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	----- -----			-	. (STANDARD ONLY)		
	210-0457-00	B086865		4	. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
	----- -----			-	. (STANDARD ONLY)		
	210-0407-00	B010100	B087104	4	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	----- -----			-	. (OPTION 2 ONLY)		
	210-0457-00	B087105		4	. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
	----- -----			-	. (OPTION 2 ONLY)		
	210-0407-00	B010100	B086879	4	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	----- -----			-	. (OPTION 4 ONLY)		
	210-0457-00	B086880		4	. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
	----- -----			-	. (OPTION 4 ONLY)		
	210-0407-00	B010100	B086884	4	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	----- -----			-	. (OPTION 21 ONLY)		
	210-0457-00	B086885		4	. NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
	----- -----			-	. (OPTION 21 ONLY)		
	334-2246-00	B010100	B086864	1	. MARKER,IDENT:MKD 120-0866-01,50-400HZ	80009	334-2246-00
	----- -----			-	. (STANDARD ONLY)		
	000-5502-00	B086865		1	. MARKER,IDENT:MARKED 120-0866-02	80009	000-5502-00
	----- -----			-	. (STANDARD ONLY)		
	334-2246-00	B010100	B087104	1	. MARKER,IDENT:MKD 120-0866-01,50-400HZ	80009	334-2246-00
	----- -----			-	. (OPTION 2 ONLY)		
	000-5502-00	B087105		1	. MARKER,IDENT:MARKED 120-0866-02	80009	000-5502-00
	----- -----			-	. (OPTION 2 ONLY)		
	334-2246-00	B010100	B086879	1	. MARKER,IDENT:MKD 120-0866-01,50-400HZ	80009	334-2246-00
	----- -----			-	. (OPTION 4 ONLY)		
	000-5502-00	B086880		1	. MARKER,IDENT:MARKED 120-0866-02	80009	000-5502-00
	----- -----			-	. (OPTION 4 ONLY)		
	334-2246-00	B010100	B086884	1	. MARKER,IDENT:MKD 120-0866-01,50-400HZ	80009	334-2246-00
	----- -----			-	. (OPTION 21 ONLY)		
	000-5502-00	B086885		1	. MARKER,IDENT:MARKED 120-0866-02	80009	000-5502-00
	----- -----			-	. (OPTION 21 ONLY)		
-117	255-0334-00			1	PLASTIC CHANNEL:12.75 X 0.175X 0.155,NYL	11897	122-37-2500
-118	337-2301-00			1	SPACER,SLEEVE:LINE VOLTAGE	80009	337-2301-00
-119	200-0237-01	B010100	B041159	1	COVER,FUSE HLDR:BLACK PLASTIC	80009	200-0237-01
	200-0237-03	B041160	B085319	1	COVER,FUSE HLDR:	80009	200-0237-03
	200-0237-04	B085320		1	COVER,FUSE HLDR:PLASTIC	80009	200-0237-04
-120	352-0362-00			1	FUSEHOLDER: W/MOUNTING HARDWARE	75915	345001
-121	131-0775-00	B010100	B085624	2	CONTACT,ELEC:HEX,0.25 INCH W/6-32 1 END	88245	1601-A
	131-2368-00	B085625		2	TERMINAL,STUD:0.601 L,INSULATED	71279	5702432-020100
-122	----- -----			1	SWITCH,SLIDE:LINE SELECTOR(SEE S701 REPL)		
					(ATTACHING PARTS)		
-123	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-124	210-0201-00	B010100	B041709	2	TERMINAL,LUG:SE #4	86928	A373-157-2
	210-0202-00	B041710		2	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
					(ATTACHING PARTS)		
-125	210-0551-00	B010100	B041709	2	NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
	210-0457-00	B041710		2	NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	210-0407-00			3	NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
	210-0551-00			4	NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
-126	200-0072-00			1	NUT,PLAIN,KNURL:0.25-28 X 0.375OD X 0.625L	80009	200-0072-00
-127	355-0503-00			1	STUD,SHOULDERED:BINDING POST,BRS NP	80009	355-0503-00
					(ATTACHING PARTS)		
-128	210-0410-00			1	NUT,PLAIN,HEX.:10-32 X 0.312 INCH,BRS	73743	2X20003-402
-129	210-0010-00			1	WASHER,LOCK:INT,0.20 ID X0.376" OD,STL	78189	1210-00-00-0541C
					- - - * - - -		
-130	----- -----			2	SEMICOND DEVICE:POWER(SEE CR703,CR703 REPL)		
					(ATTACHING PARTS)		
-131	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-132	131-0621-00			4	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-133	352-0203-00			1	HLDR,TERM CONN:7 WIRE BLACK	80009	352-0203-00
-134	----- -----			1	PHONE JACK:PRESS/PULSE OUT(SEE J603 REPL)		
-135	----- -----			1	PHONE JACK:ALARM(SEE J1582 REPL)		
-136	----- -----			1	PHONE JACK:ECG OUTPUT(SEE J605 REPL)		
-137	210-0012-00			3	WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
-138	386-3514-00			1	PLATE,CONN MTG:REAR PANEL	80009	386-3514-00
					(ATTACHING PARTS)		
-139	211-0033-00	B010100	B020244	4	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	OBD
	211-0097-00	B020245		4	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	210-0004-00	B020245		4	WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
					- - - * - - -		
-140	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-141	131-0707-00			2	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-142	352-0169-00			1	HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-143	175-0825-00			FT	WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-144	131-0707-00			2	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-145	352-0161-00			1	HLDR,TERM CONN:3 WIRE BLACK	80009	352-0161-00
-146	366-1495-00			1	KNOB:GRAY	80009	366-1495-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-147	----- -----			1	RES.,VAR:ALARM LOUDNESS(SEE R695 REPL)		
					(ATTACHING PARTS)		
-148	210-0583-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-149	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					- - - * - - -		
-150	175-0826-00	B010100	B062970	FT	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	175-0076-00	B062971		FT	CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
-151	131-0621-00			3	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-152	352-0199-00			1	CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-153	----- -----			1	SWITCH,SLIDE:TEMPERATURE(SEE S1425 REPL)		
					(ATTACHING PARTS)		
-154	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-155	175-0829-00			FT	WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-156	131-0707-00			6	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-157	352-0164-00			1	CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
-158	----- -----			1	PHONE JACK:TEMP SENSOR IN(SEE J1410 REPL)		
-159	210-0012-00	XB052940		1	WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
-160	175-0827-00			FT	CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-161	131-0707-00			4	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-162	352-0162-00			1	HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-163	----- -----			1	CONN,RCPT,ELEC:PULSE SENSOR IN(SEE J412 REPL)		
					(ATTACHING PARTS)		
-164	343-0617-00			1	RETAINER,CONN:PLUG GUIDE,ABS SIL GRAY	80009	343-0617-00
-165	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-166	175-0826-00	B010100	B062970	FT	WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
	175-0076-00	B062971		FT	CABLE,SP,ELEC:COAX,3 COND,W/BRAID	80009	175-0076-00
-167	131-0707-00			3	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-168	352-0163-00			1	CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00
-169	343-0144-00			2	CLAMP,LOOP:0.125 INCH ID,BLK NYLON	95987	1-8-2
					(ATTACHING PARTS)		
-170	210-0406-00			2	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-171	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-172	----- -----			1	CONN,RCPT,ELEC:PRESS XDCR IN(SEE J401 REPL)		
					(ATTACHING PARTS)		
-173	211-0014-00			2	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-174	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
	210-0004-00	XB040206		2	WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
					- - - * - - -		
-175	175-0829-00			FT	WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-176	131-0707-00			6	CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-177	352-0164-00			1	CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0164-00
-178	337-1865-00			1	SHLD,ELEC CONN:ECG,TOP	80009	337-1865-00
					(ATTACHING PARTS)		
-179	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-180	175-0330-00			FT	CABLE,SP,ELEC:3,22 AWG,SHIELDED VINYL JKT	16428	#8735
-181	131-0621-00			4	CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-182	352-0200-00			1	HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-183	----- -----			1	CONN,RCPT,ELEC:ECG INPUT(SEE J100 REPL)		
					(ATTACHING PARTS)		
-184	211-0233-00			2	SCREW,TPG,TC:4-24 X 0.438,PNH,STL,CD PL	83385	OBD
-185	210-0201-00			1	TERMINAL,LUG:SE #4	86928	A373-157-2
					- - - * - - -		
-186	348-0055-00			1	GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00
-187	337-1866-00			1	SHLD,ELEC CONN:ECG,BOTTOM	80009	337-1866-00
-188	342-0189-00			1	INSULATOR,CONN:NYLON	80009	342-0189-00
					(ATTACHING PARTS)		
-189	213-0267-00			2	SCREW,MACHINE:4-24 X 0.375 INCH,PNH STL	83385	OBD
					- - - * - - -		
-190	348-0359-00	B010100	B042432	4	FOOT,CABINET:SIL GRAY NYLON	80009	348-0359-00
	348-0359-01	B042433		4	FOOT,CABINET:SILVER GRAY,PLASTIC	80009	348-0359-01
					(ATTACHING PARTS)		
-191	211-0552-00			8	SCREW,MACHINE:6-32 X 2 INCH,PNH STL	83385	OBD
					- - - * - - -		
-192	333-2141-00	B010100	B041709	1	PANEL,REAR:	80009	333-2141-00
	333-2141-01	B041710	B084679	1	PANEL,REAR:	80009	333-2141-01
	333-2141-03	B084680	B086274	1	PANEL,REAR:	80009	333-2141-03
	333-2141-04	B086275		1	PANEL,REAR:	80009	333-2141-04
	333-2141-00	B010100	B041709	1	PANEL,REAR:	80009	333-2141-00
	----- -----			-	(OPTION 4 ONLY)		
	333-2141-01	B041710	B084679	1	PANEL,REAR:	80009	333-2141-01
	----- -----			-	(OPTION 4 ONLY)		
	333-2141-03	B084680	B086112	1	PANEL,REAR:	80009	333-2141-03
	----- -----			-	(OPTION 4 ONLY)		
	333-2141-04	B086113		1	PANEL,REAR:	80009	333-2141-04
	----- -----			-	(OPTION 4 ONLY)		
					(ATTACHING PARTS)		
-193	210-0586-00	B010100	B084679	4	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
	210-0586-00	B084680		8	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
	210-0457-00	XB086275		1	NUT,PL,ASSEM WA:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
	198-4055-00	B010100	B019999	1	WIRE SET,ELEC:	80009	198-4055-00
	198-4066-01	B110000		1	WIRE SET,ELEC:	80009	198-4066-01
	198-2325-00	B010100	B089999	1	WIRE SET,ELEC:	80009	198-2325-00
	----- -----			-	(STANDARD ONLY)		
	198-2325-01	B090000	B109999	1	WIRE SET,ELEC:	80009	198-2325-01
	----- -----			-	(STANDARD ONLY)		
	198-2325-02	B110000		1	WIRE SET,ELEC:	80009	198-2325-02
	----- -----			-	(STANDARD ONLY)		
	198-3564-00	B010100	B089999	1	WIRE SET,ELEC:	80009	198-3564-00
	----- -----			-	(OPTION 2 ONLY)		
	198-3564-01	B090000	B109999	1	WIRE SET,ELEC:	80009	198-3564-01
	----- -----			-	(OPTION 2 ONLY)		
	198-3564-02	B110000		1	WIRE SET,ELEC:	80009	198-3564-02
	----- -----			-	(OPTION 2 ONLY)		
	198-3579-00	B010100	B089999	1	WIRE SET,ELEC:	80009	198-3579-00
	----- -----			-	(OPTION 4 ONLY)		
	198-3579-01	B010100	B109999	1	WIRE SET,ELEC:	80009	198-3579-01
	----- -----			-	(OPTION 4 ONLY)		
	198-3579-02	B110000		1	WIRE SET,ELEC:	80009	198-3579-02
	----- -----			-	(OPTION 4 ONLY)		

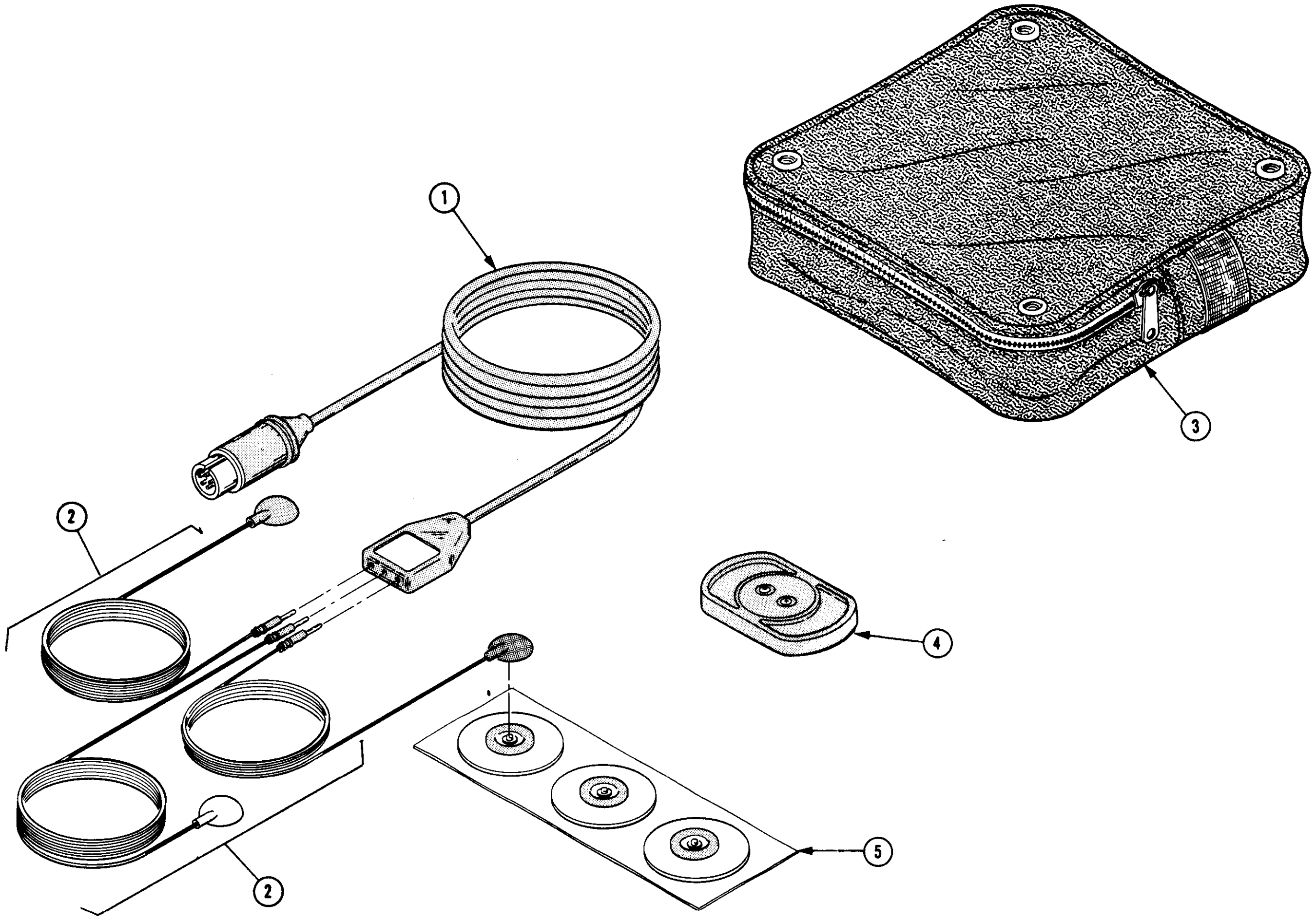


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	016-0560-02			1	POUCH,ACCESSORY:	80009	016-0560-02
9-3-1	012-0445-00			1	. LEAD,TEST,MED:PATIENT CA,TORSO,10 FEET L	80009	012-0445-00
	159-0044-00			1	. FUSE,CARTRIDGE:3AG,0.2A,250V,SLOW BLOW	71400	MDL 2/10
-2	012-0502-00	B010100	B084399	2	. LEAD SET,TEST,M:SET OF THREE	80009	012-0502-00
	012-0502-00	B084400		1	. LEAD SET,TEST,M:SET OF THREE	80009	012-0502-00
-3	016-0560-00			1	. POUCH,ACCESSORY:MEDICAL MONITOR	0000H	016-0560-00
-4	014-0054-00			1	. ADAPTER,MTG:W/PLATE AND HDWR	80009	014-0054-00
-5	119-0353-00			3	ELCTD PADS,PHY:PACKAGE OF THREE	02318	65375-030
	070-2041-00			1	MANUAL,TECH:OPERATORS	80009	070-2041-00
	070-2042-01			1	MANUAL,TECH:SERVICE	80009	070-2042-01

MANUAL CHANGE INFORMATION

PRODUCT 414 PATIENT MONITOR

CHANGE REFERENCE C6/577

DATE 5-12-77

CHANGE:	DESCRIPTION

OPTION 4

This manual insert describes the features of the 414 Option 4 that differ from the features of the standard 414. The differences are primarily that the Option 4 instruments are equipped with an 9-position ECG LEAD SELECTOR switch, a modified patient cable connector, and a 5-wire patient cable.

The 3 ECG Lead Selector pushbuttons have been replaced by an 9-position rotary switch; 7 positions of which provide correct internal connections for the following lead configurations -- I, II, III, aV_R, a V_L, aV_F, and V. The 8th position is Std and, with the switch in this position, all patient leads are disconnected, the Lead Fault indicator is disabled, and a quiescent trace (modulated by the added 1 mV CAL pushbutton) is provided. The 9th position removes the ECG trace from the display screen.

The added 1 mV CAL pushbutton switch on the front panel functions in all positions of the ECG Lead Selector Switch except the OFF position. When the pushbutton is in, it provides a calibrated +1 mV (upward-going) step in the trace. When the pushbutton is out, it provides a -1 mV step equivalent to the same input from a patient lead, but without actual application of the signal to any patient cable lead.

The patient cable (10 feet long) is equipped with a 6-contact male connector. The connector is specially keyed to prevent insertion into any receptacle other than the one providing patient protection for use with ECG electrodes. The input connector has been changed to a 6-contact connector equipped with special keying to accept only the patient cable.

EFFECTIVE S/N B041480: A two-position DIAG-MON slide switch has been added on the right side panel to provide operator selection of ECG channel bandwidth. In the DIAG position, lower and upper -3 dB response points are extended to 0.05 Hz and 100 Hz respectively, for use in diagnostic analysis. The MON position restores normal monitor bandwidth of 0.2 Hz to 50 Hz.

CHARACTERISTICS

When the ECG Lead Selector switch is in the Std position, the Alarm system remains active unless deliberately turned off.

CHANGE:	DESCRIPTION

CALIBRATION

Calibration is the same as outlined in the 414 Instruction Manual except as follows: When reference is made to the ECG Shorting Connector and CMRR Leakage Test Fixture, refer to the Test Fixture pvge in this insert for the modified diagram applicable to this instrument.

ELECTRICAL PARTS LIST CHANGES

ADD:

C106	283-0128-00	CAP.,FXD,CER DI:100PF,5%,500V
C108	283-0128-00	CAP.,FXD,CER DI:100PF,5%,500V
C180	283-0239-00	CAP.,FXD,CER DI:0.022 UF,10%,50V
DS106	150-0173-00	LAMP,GLOW:
DS108	150-0173-00	LAMP,GLOW:
R100	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R101	315-0333-00	RES.,FXD,CMPSN:33K OHM,5%,0.25W
R103	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R105	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R106	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R109	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R118	321-0217-00	RES.,FXD,FILM:1.78K OHM,1%,0.125W
R119	311-1237-00	RES.,VAR,NONWIR:1K OHM,10%,0.50W
R220	315-0135-00	RES.,FXD,CMPSN:1.3M OHM,5%,0.25W
R619	321-0013-00	RES.,FXD,CMPSN:13.3 OHM,1%,0.125W
S115	260-1573-01	SWITCH,PUSH:1MV,CAL
S120	260-0816-00	SWITCH,SLIDE:DIAG-MON

CHANGE TO:

A1	670-3677-04	CKT BOARD ASSY:ECG
C179	283-0239-00	CAP.,FXD,CER DI:0.022UF,10%,50V
R219	315-0335-00	RES.,FXD,CMPSN:3.3M OHM,5%,0.25W
R613	321-0030-00	RES.,FXD,FILM:20 OHM,1%,0.125W
S110	263-1154-00	SWITCH,ROTARY:ECG, 9 POSITION

PRODUCT 414 PATIENT MONITOR CHANGE REFERENCE C6/577 DATE 5-12-77

CHANGE:	DESCRIPTION

MECHANICAL PARTS LIST CHANGES

ADD:

407-2007-00	1	BRACKET,SWITCH
342-0397-00	1	SHIELD,INSULATING
210-0001-00	2	WASHER,LOCK,0.092 ID X 0.175 OD
210-0405-00	2	NUT,PLAIN,HEX.,2-56 X 0.188,BRS
211-0087-01	2	SCREW,MACHINE, 2-56 X 0.188,GHS
352-0202-00	1	HOLDER,6-TURN,BLACK
366-1495-00	1	KNOB,GRAY
366-1557-05	1	PUSHBUTTON, 1mV
376-0008-00	1	COUPLER
384-1136-00	1	SHAFT,EXTENSION,PUSHBUTTON
384-1294-00	1	SHAFT,EXTENSION,NYLON

CHANGE TO:

390-0580-00	1	CABINET,TOP
333-2338-00	1	PANEL,FRONT
129-0524-00	1	POST,HEX,SHIELD MOUNTING
131-1644-00	1	CONNECTOR,ECG
337-2119-00	1	SHIELD,ECG BOARD
337-2120-00	1	SHIELD,ECG BOARD
333-2354-00*	1	PANEL,FRONT
333-2355-00**	1	PANEL,FRONT

*When Option 4 is combined with Option 20

**When Option 4 is combined with Option 21

REMOVE:

366-1402-95	1	KNOB,GRAY,I
366-1402-96	1	KNOB,GRAY,II
366-1402-97	1	KNOB,GRAY,III
366-1402-98	1	KNOB,GRAY,OFF
384-1099-00	4	SHAFT,PUSHBUTTON

STANDARD ACCESSORIES

(The following list is a complete replacement)

012-0452-00	1	CABLE ASSEMBLY,PATIENT
014-0054-00	1	ADAPTER,MOUNTING
016-0560-00	1	POUCH,ACCESSORY
012-0580-00	1	ELECTRODE LEAD SET

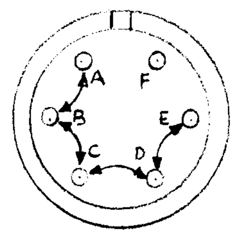
CHANGE:	DESCRIPTION

STANDARD ACCESSORIES

119-0353-00 2 ELECTRODE PAD,PACKAGE OF THREE

Change: Fig. 5-1 Part B

B. ECG SHORTING CONNECTOR

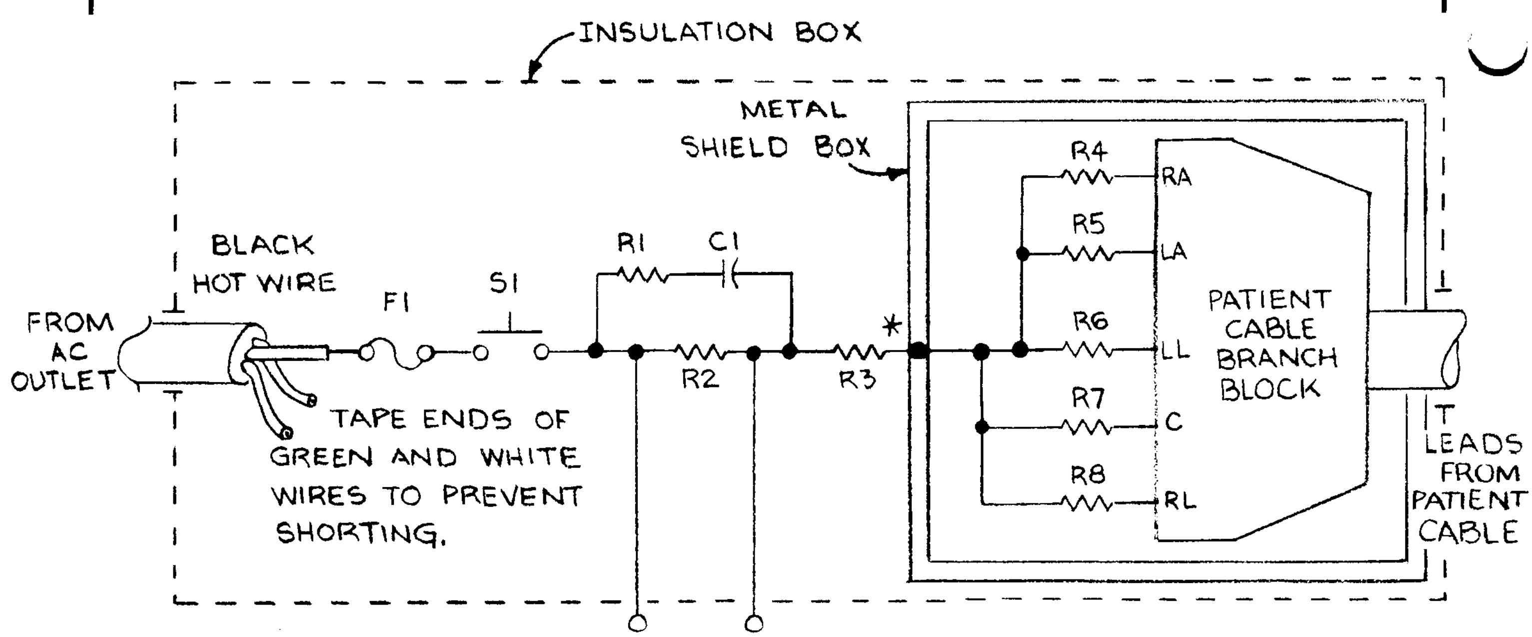


SHORT PINS A,B,C,D,E
(PLUG REAR VIEW SHOWN)

Modified MS3106A-14S-6P with keyway rotated 30° to be halfway between Pins A and F.

Change: Fig. 5-2 Part B

B. CMRR-LEAKAGE TEST FIXTURE



* MAKE CERTAIN R3 CONNECTS TO METAL SHIELD BOX

J1, J2 TO TEST OSCILLOSCOPE

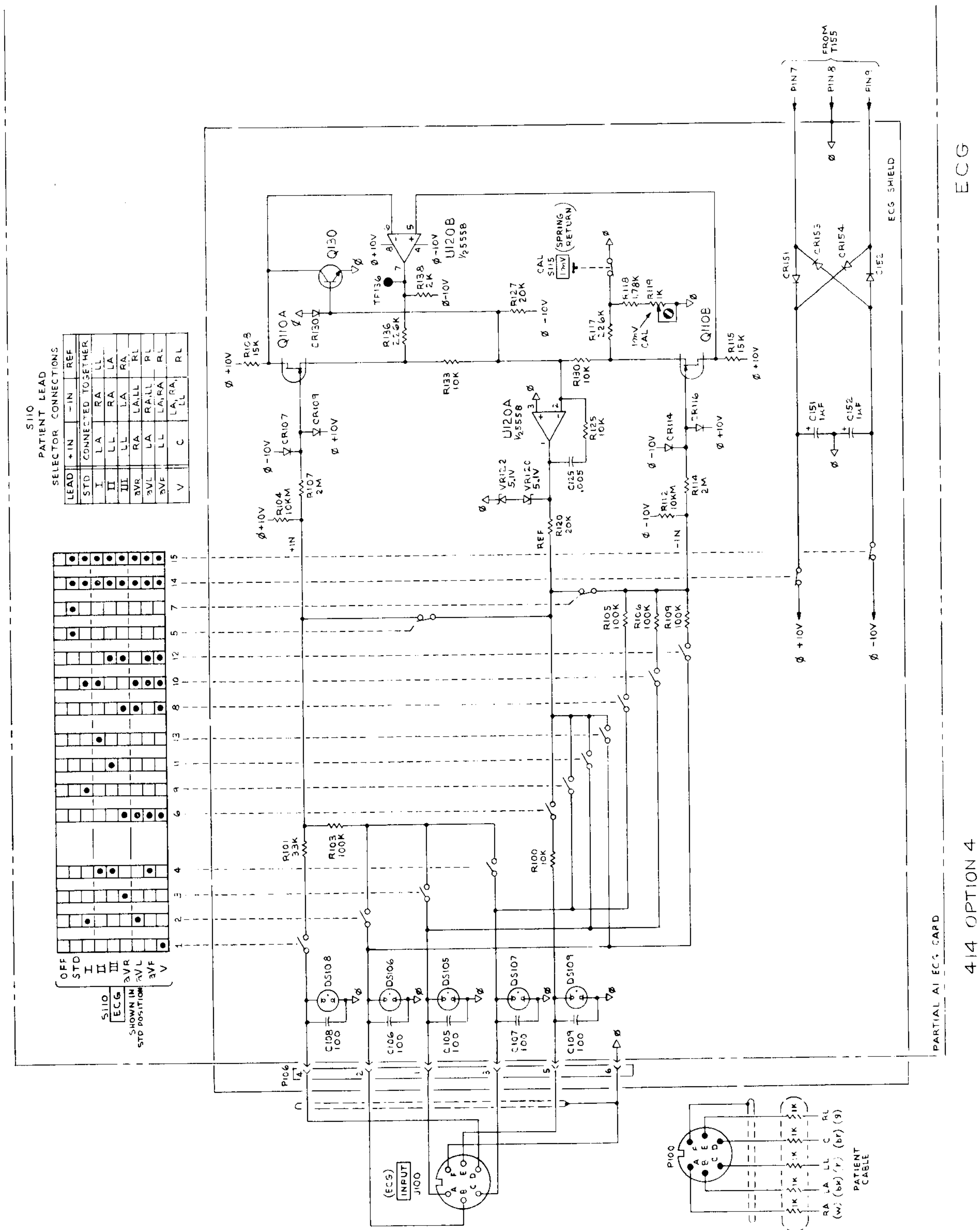
C1 - .15μF 10%
F1 - 5mA
J1,J2 - INSULATED JACKS
R1 - 10Ω 10%
R2 - 1KΩ 1%
R3 - 1MΩ 5%
R4 - 15KΩ 5%
R5 - 5.1KΩ 5%
R6 - 10KΩ 5%
R7 - 10KΩ 5%
R8 - 10KΩ 5%
S1 - SINGLE POLE NORMAL OPEN PUSHBUTTON

PRODUCT 414 PATIENT MONITOR CHANGE REFERENCE C6/577 DATE 5-12-77

CHANGE:	DESCRIPTION

SCHEMATIC CHANGES

DIAGRAM ⟨1⟩ ECG - Partial



PRODUCT 414 PATIENT MONITOR CHANGE REFERENCE C6/577 DATE 5-12-77

CHANGE:	DESCRIPTION

SCHEMATIC CHANGES

DIAGRAM ⟨4⟩ ECG - Partial

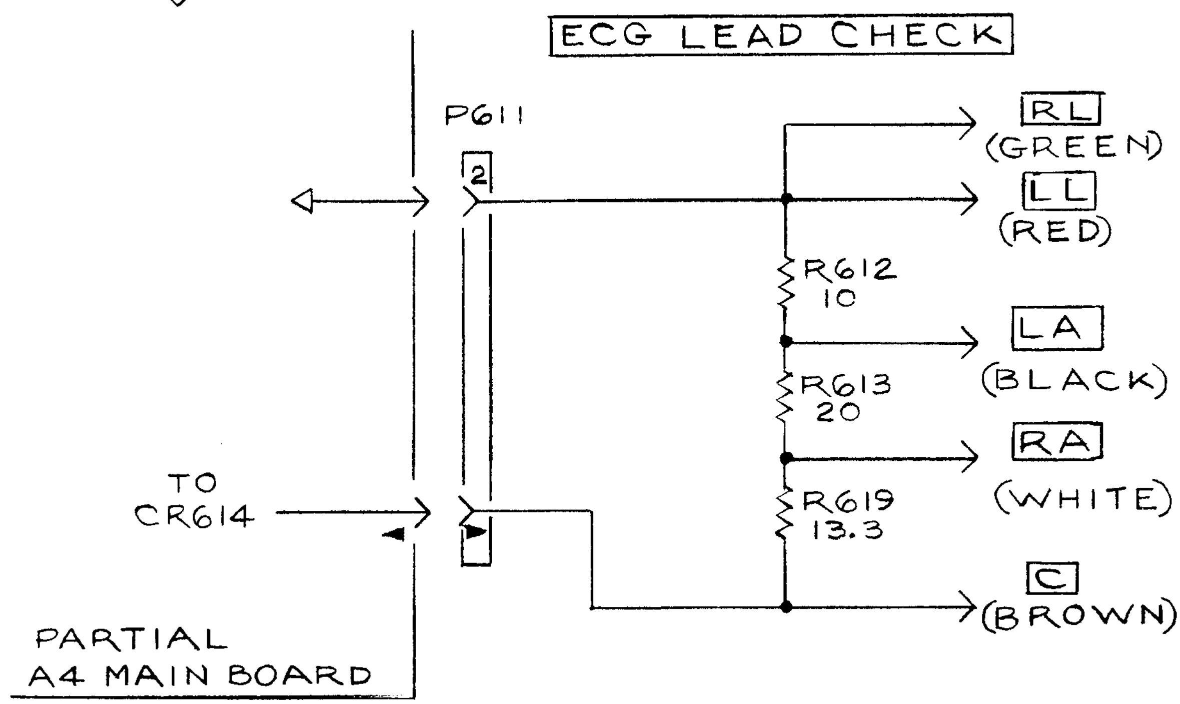
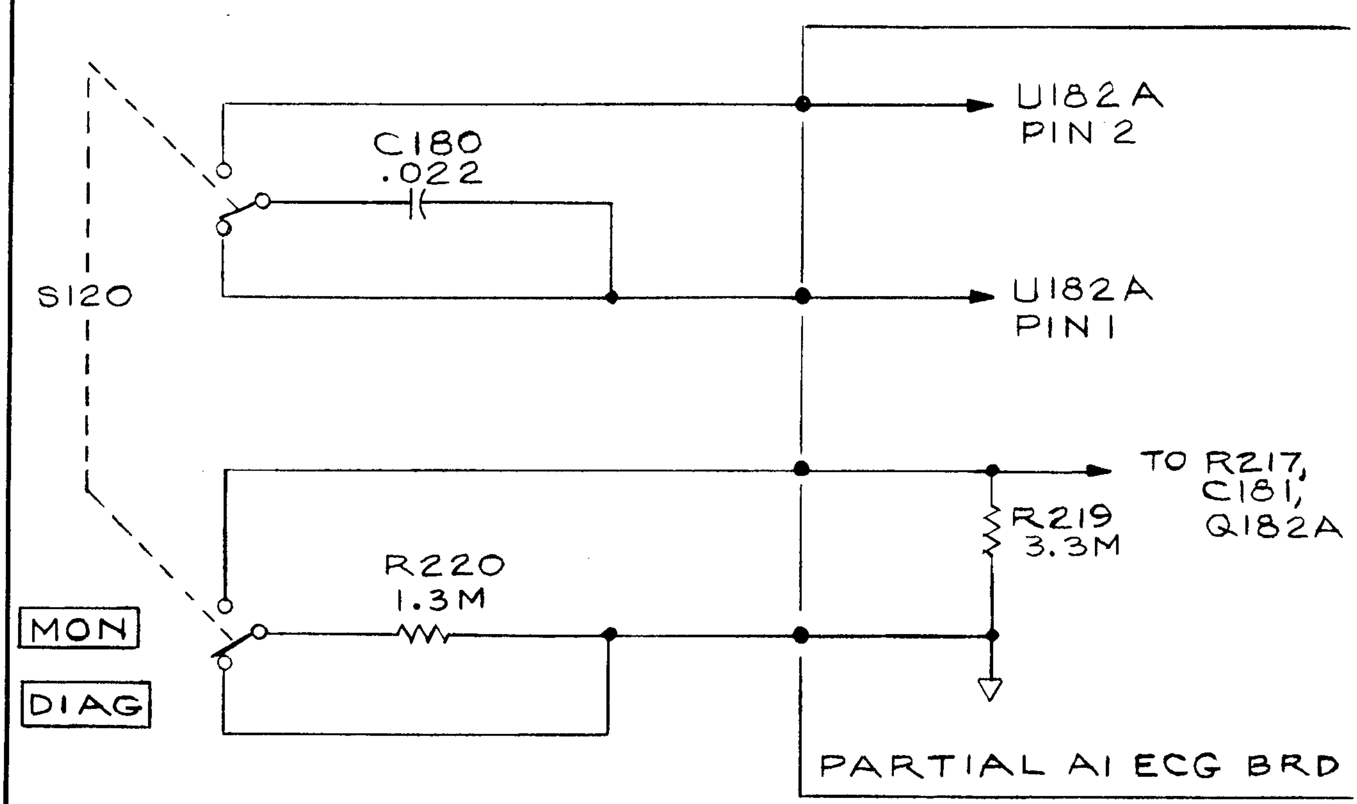


DIAGRAM ⟨1⟩ VERTICAL & HORIZONTAL AMPLIFIERS - Partial



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MANUAL CHANGE INFORMATION

Date: 9-4-79 Change Reference: C11/979

Product: 414 SERVICE Manual Part No.: 070-2042-01

DESCRIPTION

TEXT CORRECTIONS

Page 1-2, right column, third paragraph

CHANGE TO READ:

The monitor is intended for use with dual-temperature probe Models 701 and 702 manufactured by the Yellow Springs Instrument Co., Box 279, Yellow Springs, Ohio 45387. These probes will withstand full ac power source voltage with less than 10 μA leakage current. Other temperature probes should not be used with this monitor.

Page 1-5, center column, first row

CHANGE TO READ:

Temperature Probe Models 701 and 702
by Yellow Springs Instrument Co.

Page 1-7, right column, fifth row

CHANGE TO READ:

With Yellow Springs Instrument Co.
probe Models 701 or 702

MANUAL CHANGE INFORMATION

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PRODUCT 414 PATIENT MONITOR	CHANGE REFERENCE C5/577
	DATE 5-10-77

CHANGE:	DESCRIPTION

070-2042-01

OPTION 2

This manual insert describes the features of the 414 Option 2 that differ from the features of a standard 414. The differences are primarily that the Pressure Channel GAGE FACTOR screwdriver control is removed from the Pressure/Pulse board and is relocated on the instrument rear panel for easy operator access.

GAGE FACTOR Control

Range. The control varies the bridge voltage supply a minimum of ±5% from its nominal 7.5 V value. This adjustment range will provide direct calibration for transducers having outputs from 47.5 to 52.5 μV/V/cm (Hg). Somewhat greater range is provided in the direction of higher output transducers (typically to 57 μV or greater).

Use. The GAGE FACTOR control may be used in conjunction with the front-panel 100 mm CHECK pushbutton to provide gage-factor correction and direct display calibration under the following conditions:

1. The specified transducer output is within the range 47.5 to 52.5 μV/V/cm (Hg).

2. The transducer and its internal calibrating resistor conform to the requirements of the Tektronix specification for pressure transducers for use with the 414 Monitor.

3. The actual gage-factor (true calibration) of the transducer has not changed since the calibrating resistor was installed.

NOTE: In case of doubt, the GAGE FACTOR adjustment should be made only by use of known pressure input to the transducer as verified by an external manometer.

CALIBRATION NOTE

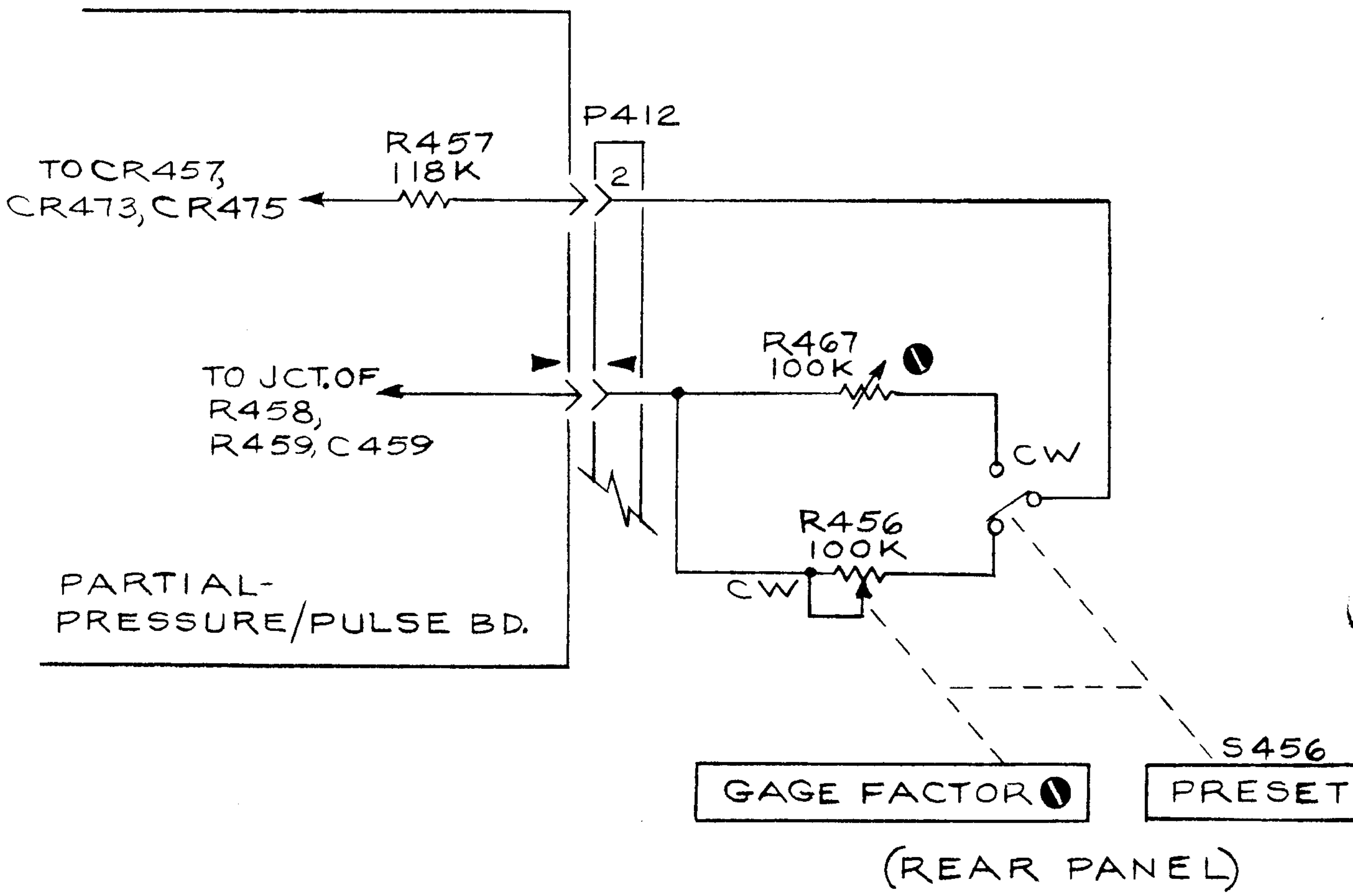
The pulse sensor excitation voltage will also be variable. Sensor types having incandescent lamps should be operated with GAGE FACTOR set at midrange. Continued operation at maximum excitation voltage will substantially shorten lamp life.

OPTION 2

PRODUCT 414 PATIENT MONITOR CHANGE REFERENCE C5/577 DATE 5-10-77

CHANGE:	DESCRIPTION

DIAGRAM ⟨3⟩ PRESSURE/PULSE



414 OPTION 2

PRODUCT	CHANGE REFERENCE	DATE
414 PATIENT MONITOR	OPTION 2 C5/577	5-10-77

CHANGE:	DESCRIPTION

ELECTRICAL PARTS LIST CHANGES

ADD:

R467	311-1555-00	RES.,VAR,NONWIR:100K OHM,20%,0.5W,TRIMMER
S456 *		SWITCH,SPDT,PRESET

CHANGE TO:

R456	311-1949-00	RES.,VAR,NONWIRK:100K OHM,20%,1W,w/SPDT SWITCH

*Furnished as a unit with R456.

MECHANICAL PARTS LIST CHANGES

ADD:

220-0808-00	1	NUT,SLEEVE MOUNTING,0.25-32 HEX
131-0707-00	2	CONNECTOR,TERMINAL,0.48" LONG
175-0825-00	1	CABLE,ELEC.,2-WIRE RIBBON
210-0046-00	1	WASHER,LOCK0.26 ID X 0.40 OD
366-0261-01	1	KNOB, THUMB ADJ.

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MANUAL CHANGE INFORMATION

PRODUCT 400, 401, 408,412 413 & 414 SERVICE MANUALS

CHANGE REFERENCE C8/378

DATE 3-15-78

CHANGE:	DESCRIPTION

BATTERY USE AND CARE

THIS INFORMATION SUPERSEDES ALL SIMILAR INFORMATION CONTAINED ELSEWHERE IN THIS MANUAL

CONTENTS OF THIS SECTION:

1. BATTERY CHARGING INSTRUCTIONS AND RELATED INFORMATION,
2. INSTRUCTIONS FOR A PERIODIC BATTERY-OPERATING-TIME TEST WHICH THE USER SHOULD PERFORM,
3. A CHART WHICH SHOWS THE BATTERY CHARGING AND OPERATING TIMES APPROPRIATE FOR VARIOUS MONITORS, AND
4. A MAINTENANCE PLAN FOR QUALIFIED SERVICE PERSONNEL.

1. BATTERY CHARGING INSTRUCTIONS

A. 16 HOURS MINIMUM ARE REQUIRED TO RECHARGE A DEPLETED BATTERY. CONNECT THE LINE CORD PLUG TO A "HOSPITAL GRADE" AC OUTLET.

LONGER CHARGING TIME IS REQUIRED UNDER CERTAIN CIRCUMSTANCES. SEE THE TIME CHART ON A LATER PAGE OF THIS SECTION.

B. CHARGE IN A COOL PLACE; PREFERABLY NO WARMER THAN +22°C (≈+72°F).

HIGHER TEMPERATURES PREVENT THE BATTERY FROM ACCEPTING MAXIMUM CHARGE. LONGER CHARGING TIME WILL ONLY PARTIALLY COMPENSATE FOR A HIGH TEMPERATURE. NO CHARGING WILL OCCUR WHEN THE TEMPERATURE EXCEEDS +40°C (+104°F).

MAXIMUM BATTERY OPERATING TIME IS OBTAINED WHEN CHARGING IS DONE WITH THE MONITOR TURNED

CHANGE:	DESCRIPTION

OFF AND IN A COOL PLACE. WITH THE MONITOR OFF, THE INTERNAL TEMPERATURE WILL BE LOWER.

C. AVOID EXCESSIVE CHARGING.

IF THE MONITOR IS NOT BEING USED, TURN IT OFF. UNPLUG IT FROM THE AC OUTLET WHEN THE BATTERY IS FULLY CHARGED.

THE BATTERY WILL GRADUALLY DISCHARGE ITSELF OVER A TWO TO SIX MONTH PERIOD AND WILL, THEREFORE, REQUIRE RECHARGING WHEN IT IS AGAIN PLACED INTO USE.

APPLICATIONS, SUCH AS USE IN INTENSIVE CARE, MAY REQUIRE CONTINUOUS USE AND, THEREFORE, WILL REQUIRE THE MONITOR TO BE CONTINUOUSLY CONNECTED TO AN AC OUTLET. WEEKS OR MONTHS OF EXCESSIVE CHARGING RESULT. WHEN NEXT USED ON BATTERY, THE OPERATING TIME MAY BE SIGNIFICANTLY LESS THAN THE LISTED, TYPICAL AMOUNT.

2. BATTERY OPERATING TIME TEST

OCCASIONALLY CHECK OPERATING TIME AS FOLLOWS:

A. CHARGE FULLY. SEE THE TIME CHART ON A LATER PAGE OF THIS SECTION.
B. OPERATE MONITOR ON BATTERY UNTIL AUTOMATIC SHUTDOWN OCCURS.
C. NOTE THE OPERATING TIME.

IF THE OPERATING TIME IS SIGNIFICANTLY LESS THAN LISTED ON THE CHART AND BECOMES, THEREFORE, UNSUITABLE FOR YOUR APPLICATION, REFER THE MONITOR FOR SERVICE.

TEKTRONIX MEDICAL MONITORS
BATTERY CHARGING AND OPERATING TIMES

Monitor Type	Charging Hours @ 20-25°C Ambient			Operating Hours ①②	
	D-Cell Battery	F-Cell Battery		D-Cell Battery	F-Cell Battery
	Either Operating Or Not	Not Operating	Fully Operating	Typical	Typical
408 Monitor	16	16	18	3.5	5.6
w/400 Recorder	③	16	20④		5.3④
w/400 Recorder	③	16	26⑤		4.6⑤
412 Monitor	16	16	18	2.5	4.0
w/400 Recorder	③	16	20④		3.8④
w/400 Recorder	③	16	26⑤		3.3⑤
413 Monitor	16	16	18	1.6	2.6
w/400 Recorder	③	16	20④		2.5④
w/400 Recorder	③	16	26⑤		2.3⑤
w/401 DRM	③	16	50		1.9
w/Both 400 & 401	③	16	⑦		1.8④
414 Monitor	16	16	18	1.7	2.7
w/400 Recorder	③	16	20④		2.6④
w/400 Recorder	③	16	26⑤		2.4⑤
w/400 Recorder	③	16	22⑥		2.5⑥
w/401 DRM	③	16	50		2.1
w/Both 400 & 401	③	16	⑦		2.0④

Footnotes:

1. Operating times listed are for new battery packs which have been charged while the monitor is turned off. For battery packs charged while the monitor was operating, reduce the listed time by about one-third.
2. Operating times listed assume that all monitor capabilities are being used and with typical trace positions and sizes.
3. Combination not recommended.
4. With Recorder producing four 14-second strips per hour.
5. With Recorder producing twenty 14-second strips per hour.
6. With Option 3 Recorder producing four 28-second strips per hour.
7. Monitor can be operating, but either or both the Recorder or DRM must be turned off for charging to take place.

4. MAINTENANCE

THE FOLLOWING PROCEDURES ARE TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

WHEN A BATTERY PROVIDES SIGNIFICANTLY LESS THAN THE RATED OPERATING TIME, THERE ARE THREE ALTERNATIVES:

A. REPLACE IT WITH A NEW BATTERY, OR
B. ATTEMPT TO REJUVENATE THE BATTERY, OR
C. CONTINUE TO USE THE BATTERY, AS IS.

ATTEMPTED REJUVENATION CARRIES THE RISK THAT ONE OR MORE CELLS MAY BECOME SHORT CIRCUITED INTERNALLY AND MUST THEN BE REPLACED. THIS RISK IS OF LITTLE CONSEQUENCE IF IT HAS ALREADY BEEN DECIDED THAT THE BATTERY CAN NO LONGER BE USED.

REJUVENATION CONSISTS OF:

A. DEEP DISCHARGE
B. RECHARGE
C. DEEP DISCHARGE
D. RECHARGE

THIS PROCEDURE SHOULD CORRECT ANY ACCUMULATED CHARGE IMBALANCE AND REFORM THE CRYSTALLINE STRUCTURE OF THE CELL PLATES. IF ADEQUATE OPERATING TIME IS NOT RESTORED, THE BATTERY SHOULD BE REPLACED.

DEEP DISCHARGE IS ACCOMPLISHED BY CONNECTING A RESISTOR ACROSS THE BATTERY. RESISTOR VALUE SHOULD BE ABOUT TEN OHMS AND THE POWER RATING SHOULD BE AT LEAST FIVE WATTS (TEK PART NO. 308-0399-00). THE RESISTOR WILL GET HOT, SO TAKE APPROPRIATE PRECAUTIONS. THE RESISTOR SHOULD REMAIN CONNECTED UNTIL THE BATTERY VOLTAGE DROPS BELOW ONE VOLT.

CHANGE:	DESCRIPTION

BATTERY RECHARGING CAN, OF COURSE, BE ACCOMPLISHED THROUGH IT'S MONITOR, BUT YOUR MONITORS NEED NOT BE KEPT IN THE MAINTENANCE AREA WHILE THIS REJUVENATION IS PERFORMED. THE MONITOR CAN BE USED ON AC LINE WITHOUT A BATTERY INSTALLED (UNLESS THE MONITOR IS EQUIPPED WITH A 400 RECORDER AND/OR A 401 DIGITAL READOUT MODULE). HOWEVER, THIS MAY BE INCOMPATIBLE WITH THE USER'S NEEDS.

RECHARGING SHOULD BE DONE WITH A RELATIVELY CONSTANT CURRENT SOURCE, NOT A VOLTAGE SOURCE AS WITH LEAD-ACID BATTERIES. THIS CAN BE ACCOMPLISHED BY PUTTING A SUITABLE RESISTOR IN SERIES WITH A POWER SUPPLY. THE PACK VOLTAGE WILL RANGE FROM AS LOW AS 4.6 VOLTS DURING THE LATTER PHASE OF DISCHARGING TO AS HIGH AS 6 VOLTS DURING THE LATTER PHASE OF CHARGING.

THE RECOMMENDED CHARGING CURRENTS FOR THIS PURPOSE ARE:

D - CELLS	250 TO 350 mA	(BATTERY PACK - TEK PART No.: 119-0441-01)
F - CELLS	400 TO 600 mA	(BATTERY PACK - TEK PART No.: 119-0443-01)

THE FOLLOWING IS RECOMMENDED. BUY EXTRA BATTERY PACKS, PERHAPS ONE EXTRA FOR EACH FIVE MONITORS IN USE. IF YOU USE BOTH "D" AND "F" CELL BATTERIES, THEY MUST BE CONSIDERED SEPARATELY. PUT A NEW BATTERY IN THE MONITOR AND RETURN IT FOR USE WHILE THE REJUVENATION PROCEDURE IS PERFORMED. (NOTE: MONITORS EQUIPPED WITH D-CELL PACKS CAN BE CONVERTED TO F-CELL PACKS BY INSTALLING AN F-CELL MOD KIT - TEK PART No.: 040-0710-00).

IT IS SUGGESTED THAT EACH BATTERY PACK BE MARKED WITH AN IDENTIFYING NUMBER AND THAT BATTERY SERVICE RECORDS BE KEPT.

PRODUCT 400, 401, 408, 412 413, & 414 SERVICE CHANGE REFERENCE C8/378 DATE 3-15-78

CHANGE:	DESCRIPTION

BATTERY PACKS WHICH FAIL TO REJUVENATE MAY BE REPAIRABLE BY REPLACING THE DEFECTIVE CELL(S). THERE ARE SEVERAL THINGS TO KEEP IN MIND WHEN REPLACING CELLS:

1. REPLACE CELLS WHICH FAIL TO DELIVER AT LEAST 75% OF THEIR LISTED, TYPICAL OPERATING TIME.
2. WHEN A BATTERY PACK HAS BEEN IN SERVICE MORE THAN ONE YEAR, IT IS PROBABLY WISE TO REPLACE ALL OF THE CELLS WHEN THE FIRST BAD CELL IS DETECTED.
3. REPLACEMENT CELLS SHOULD BE OBTAINED FROM TEKTRONIX BECAUSE THESE SPECIAL CELLS ARE DIFFICULT TO OBTAIN OTHERWISE. LOCALLY AVAILABLE CELLS TYPICALLY HAVE LOWER CAPACITY, NARROWER TEMPERATURE RANGE AND CANNOT TOLERATE THE MAGNITUDE OF CHARGING CURRENT PROVIDED BY THE MONITOR.
4. MINIMIZE THE AMOUNT OF HEAT TRANSFERRED FROM SOLDERING IRON TO CELL BODY. BEND THE SOLDER TAB OUTWARD, AWAY FROM THE CELL BODY AND PLACE A HEAT-SINK CLIP BETWEEN THE CELL BODY AND THE SOLDER AREA. NEVER SOLDER DIRECTLY TO THE CELL BODY.

MANUAL CHANGE INFORMATION

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Date: 10-29-79 Change Reference: M36049

Product: 414 PATIENT MONITOR WITH OPTIONS Manual Part No.: 070-2042-01

DESCRIPTION

EFF SN B086157 (Standard)

EFF SN B086066 (Option 04)

EFF SN B086180 (Option 20)

EFF SN B086142 (Option 21)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

A1	670-2702-06	CKT BOARD ASSY:ECG
A1	670-3677-08	CKT BOARD ASSY:ECG (OPTION 04)

ADD:

C389	283-0111-00	CAP.,FXD,CER DI:0.1UF,20%,50V

DIAGRAM ⟨2⟩ QRS DETECTOR

C389 is added from pin 1 to pin 8 of U388 on the back of the ECG circuit board.

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MANUAL CHANGE INFORMATION

Date: 12-6-79 Change Reference: C12/1279 REV.

Product: 414 Portable PATIENT MONITOR Manual Part No.: 070-2042-01

DESCRIPTION

TEXT CORRECTIONS

Page 5-12 (Page 5-13 in some earlier manuals), Steps B6 and B7

CHANGE:

B6. QRS TIMING

a. Connect test oscilloscope channel 1 input to TP382 (ECG board) and channel 2 input to TP388. Set oscilloscope vertical mode to chop and sweep speed to 10 ms/div X10 Magnifier on. Trigger on channel 1, positive slope.

b. CHECK - Interval to first positive-going edge at TP382 is 6 ms, ±1 ms (see Fig. 5-7; 5-8 in some earlier manuals).

B7. QRS WIDTH

a. Set test oscilloscope vertical mode to channel 2 and sweep speed to 50 ms/div (X1). Trigger oscilloscope on composite or normal, + slope.

b. CHECK - Pulse duration at TP388 (ECG board) is 150 ms ±25 ms (see Fig. 5-8; 5-9 in some earlier manuals).

c. Disconnect test oscilloscope.

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MANUAL CHANGE INFORMATION

Date: 8-12-80 Change Reference: M36268

Product: 414 SERVICE EFF SN B090000 Manual Part No.: 070-2042-01

DESCRIPTION

TEXT CORRECTIONS

Page 1-1, left column, second paragraph, second line

CHANGE: the word "D-cell[1]" to F-cell[1]

Page 1-1, bottom of page

CHANGE; footnote [1] to read: [1]An F-cell battery pack is standard after Serial No. B084100.

Page 1-2, left column, following third paragraph

ADD:

WARNING

Avoid electrocautery burns at monitoring sites by ensuring proper connection of the electrocautery return circuit. If improperly connected, many older electrocauterizers allow other return paths, even through fully isolated patient monitors.

Page 1-2, right column, second paragraph

CHANGE TO READ:

Temperature Transducers

The monitor is intended for use with dual-temperature probe Models 701 and 702 manufactured by Yellow Springs Instrument Co., Box 279, Yellow Springs, Ohio 45387. These probes will withstand full ac power source voltage with less than 10 μA leakage current. Other temperature probes should not be used.

Page 1-5, Table 1-1, center column, top row.

CHANGE TO READ: Temperature Probe Models 701 and 702 by Yellow Springs Instrument Co.

Page 1-7, Table 1-1, right column, fifth row

CHANGE TO READ: With Yellow Springs Instrument Co. probe Models 701 or 702.

Page 3-14, right column, starting with the Vertical Circuit Operation (bottom paragraph) to page 3-18, right column, just above the Power Supply Circuit Operation heading

CHANGE TO READ:

DESCRIPTION

Vertical Circuit Operation

The Vertical Deflection circuit amplifies ECG or Pressure/Pulse-respiration waves as selected by the Trace Switching Logic circuit and drives the vertical deflection coil.

ECG Off and Pressure/Pulse & Respiration Display Off logic signals determine whether channels are displayed alone or simultaneously. When both channels are selected, a 2-kHz clock signal drives electronic switches (U625C and D), which chop between the two channels (see circuit diagram).

A 4-kHz crt blanking signal is produced during the channel-switching interval to eliminate switching transients from the display. The Vertical Boost circuit provides for rapid change of deflection-coil current during the channel-switching interval.

CLOCK OSCILLATOR AND DIVIDERS. Transistors Q620 and Q622 make up an 8-kHz oscillator. The frequency is adjustable with R601. The negative-going excursion of the 8-kHz oscillator output at the collector of Q622 turns on Q624, producing a positive-going pulse that clocks the divide-by-two counter (U615B). The 4-kHz negative-going output at pin 12 is used for chop blanking and vertical boost.

The positive-going output at pin 13 of U615B clocks U615A, another divide-by-two counter. The 2-kHz positive-going output at pin 1 is used for trace switching, sweep triggering, beat tone, and alarm tone. It also goes to the Pressure/Pulse board for pressure/pulse - respiration display switching. The negative-going output at pin 2 is used for trace switching along with the positive-going output at pin 1.

TRACE-SWITCHING LOGIC. Transmission gates U625C and D close to connect the ECG or pressure/pulse - respiration waves to the Vertical Deflection Amplifier. A HI at pin 6 of U625C connects the pressure/pulse - respiration wave to U629. When the pressure/pulse - respiration and ECG channels are on at the same time, U625C and D are closed and opened alternately by the 2-kHz clock signal to display both channels simultaneously (see Fig. 3-10 for switching logic).

CHANNEL SELECTION LOGIC. The Pressure/Pulse and Off signal from the Pressure/ Pulse board is inverted by U617E, then inverted again in two parallel inverters (U617B and F). This is to provide additional fan-out current and to standardize logic level voltage. The ECG Off signal is inverted by U617D.

DESCRIPTION

Vertical Deflection Amplifier

Integrated circuit U629 and associated circuitry form an operational amplifier configured as a voltage follower as shown in Fig. 3-11A. Output current of this stage is determined by R647, which loads the amplifier output as shown in Fig. 3-11B. The vertical deflection coil is then added in series with the output as shown in Fig. 3-11C. Thus, Fig. 3-11C shows the basic concept of the vertical amplifier.

Transistors Q636, Q638, Q646, and Q648 are current boosters for the operational amplifier output. Q632 and Q642 provide the interface between the output of U629 and the boost transistors and allow a voltage swing up to ±35 volts.

Light-emitting diodes DS628 and DS629 are used as voltage clamps to limit the input voltage for U629 to + or - 1.5 volts. This prevents the amplifier from trying to establish unnecessarily high current levels in the vertical deflection coil.

Some rapid changes at the input of U629, such as the chop transistion from one trace to another, cannot be followed instantaneously by the output. This can create a substantial difference between the input and the feedback voltages. Therefore, the bi-directional clamp, Q635 and Q637, limits Q632 and Q642 current to a value that is usable by the output stage.

A 70-microsecond vertical boost pulse from U627A causes Q630, Q634, Q640, and Q644 to switch the amplifier power supply from + and - 7 volts to + and -35 volts. This higher voltage decreases the time required for the current to change in the vertical deflection coil.

The chop blank pulse, occurring at the same time that the trace is switched, triggers 20-microsecond one-shot multivibrator U627B. Vertical boost multivibrator U627A can be triggered during the 20 microsecond HI at pin 12. If the amplifier begins to limit due to the chop transition, Q635 and Q637 are turned on. This turns on Q639 and causes pin 13 to go HI and release the reset. Pin 12 goes HI (after C628 discharges) to trigger U627B.

The resultant 70-microsecond (maximum) pulse at pin 14 of U627B turns on Q630, Q634, Q640 and Q644 to increase the output amplifier collector voltage to + and -35 volts.

DESCRIPTION

Capacitor C628 prevents U627A from resetting for the duration of the vertical boost. Transients that momentarily turn off Q639 cannot cause pin 13 to go LO until C628 charges through R628 and R629.

Horizontal Circuit Operation

The horizontal circuit consists of a trigger selector, a sweep trigger logic circuit, a sweep generator, and a horizontal defelction amplifier to drive the horizontal deflection coil.

The sweep trigger logic circuit produces an approximate 5 millisecond selected trigger signal. ECG or pressure/pulse trigger signal is selected, depending on the status of the ECG channel.

If the trigger pulses stop for about 4 seconds, the sweep trigger logic circuit gates on the sweep generator to provide a free-running baseline trace.

The sweep generator produces a sawtooth signal that is amplified by the horizontal amplifier to drive the horizontal deflection coil.

TRIGGER SELECTOR. Gates U625A and U625B select either the ECG or Pressure/Pulse trigger signal. When the ECG channel is on, U625B is closed (pin 5 HI) and U625A is open (pin 13 LO), selecting the ECG trigger signal. When the ECG channel is off U625B is open (pin 5 LO) and U625A closed (pin 13 HI), selecting the Pressure/Pulse trigger signal.

SWEEP TRIGGER LOGIC. The selected trigger signal from U625A or B triggers U661B to produce a 5 millisecond selected trigger pulse.

When pin 9 of U655A goes LO and the sweep retrace has ended, a sweep will start. If pin 9 is held LO, (by U665-3) a new sweep will be started at the end of each retrace cycle. Pin 9 goes LO whenever any of the three inputs (on pins 1, 2, or 8) go HI.

Pin 8 goes HI (through R669 to +7 V) whenever all three sweep speed pushbuttons are in the out position. Also, pin 8 goes HI at selected sweep speeds when the appropriate resistor (R661, R662, R663) is removed (for 25 mm/sec).

Pin 2 goes HI for 5 milliseconds each time a selected trigger pulse is produced by U661A.

Pin 1 goes HI to free-run the sweep if no selected triggers occur for at least 4 seconds.

DESCRIPTION

U665 is a counter that is clocked by the 2-kHz clock signal and is reset each time a 5-millisecond selected trigger pulse occurs. If the selected trigger pulses stop, U665 is not reset and counts for about 4 seconds until pin 3 goes HI and stops the clock pulses through U655B. With no clock pulses, U665 pin 3 is held HI until the selected trigger pulses resume and reset U665 by setting pin 11 HI. As long as pin 3 of U665 remains HI, pin 1 of U655A is HI and the sweep is free-running.

Flip-flop U653B widens the 5-millisecond selected trigger pulse to approximately 68 milliseconds for beat tone.

Each time a 5-millisecond selected trigger pulse occurs, U653B pin 12 is set LO and counter U665 starts counting. After 128 counts, pin 13 goes HI and clocks U653B, which causes pin 12 to go HI. Thus, with each trigger pulse, a 68-millisecond LO pulse is produced at pin 12 of U653B. This turns off CR652 and allows the 2-kHz clock signal to pass through CR651 to the audio amplifier for 68 milliseconds.

SWEEP GENERATOR. The sawtooth sweep signal is produced by counter U659 and resistive-ladder network R660. U659 is clocked by the appropriate clock pulse as selected by the SWEEP SPEED mm/SEC switch.

As U659 is clocked, its output counts in the normal binary fashion. Due to the design of the resistive-ladder network, each additional count produces an increase in the current into the horizontal deflection amplifier. Thus, a stairstep current ramp is produced that drives the horizontal deflection coil to move the electron beam across the crt screen.

At the 512th count, pin 14 of U659 goes HI, turning off Q680 and triggering one-shot U661A. U661A produces a 20-millisecond pulse that blanks the crt, sets U653A pin 1 HI, and inhibits gate U655B (pins 4 and 5 go HI) from passing further triggers. The HI at pin 1 of U653A turns on Q688, causing pin 11 of U659 to go HI and reset the counter to zero.

At the end of the 20-millisecond pulse, pins 4 and 5 of U655B go LO. If pin 3 is also LO due to a trigger pulse or to being held LO for a free-running sweep, pin 6 of U655B also goes HI. This resets U653A and causes pin 11 of U659 to go LO and allow another sweep to start.

DESCRIPTION

Sweep speeds are determined by the rate at which U659 is clocked. The 2-kHz clock signal at pin 10 of U657 is counted down to 500 Hz, 250Hz, and 125 Hz at outputs Q2, Q3, and Q4 respectively. The SWEEP SPEED mm/SEC switch selects the appropriate clock pulse from U657 to clock U659.

HORIZONTAL DEFLECTION AMPLIFIER. U668A and its follower transistors (Q670 and Q672) compose a conventional inverting operational-amplifier circuit. The deflection coil is operated in the voltage mode so that the coil current is determined by the voltage across the coil divided by the coil resistance.

The amplifier impresses a negative-going sawtooth voltage at pin 2 of P641 (deflection-coil plug). This voltage if fed through R675, RT611, and R676 to the opposing half of the horizontal deflection amplifier (U668B, Q674, and Q676). The sawtooth is inverted through U668B, which impresses a positive-going sawtooth at the other side of the horizontal deflection coil.

Thermistor RT601 compensates for changes in resistance of the horizontal deflection coil wire due to internal temperature changes.

Audio Amplifier Circuit Operation

The audio amplifier provides audible beat and alarm tones. Both tones are produced from the 2-kHz clocksignal, which is gated into the audio amplifier through CR651 and CR653 respectively.

The beat tone is produced when the trigger pulse from pin 2 of U653B turns off CR652 and allows the 2-kHz clock signal to pass through CR651 for 68 milliseconds. This signal passes through the BEAT LOUDNESS control, which sets the signal level into U649.

The alarm tone is produced when the Alarm logic signal goes HI (alarm detected), turns on CR653, and allows the 2-kHz clock signal to pass to the ALARM LOUDNESS control and U649.

ECG LEAD CHECK. The ECG LEAD CHECK circuit provides approximately 117 output pulses per minute for checking patient cable continuity, ECG circuit operation, and high-or low-rate alarm limits.

DESCRIPTION

The pulses are initiated by the Q7, Q8, Q9, and Q10 outputs of U657. A negative-going pulse occurs at the RA lead check terminal (pin 1 of P611) whenever all four outputs of the counter are LO. When the outputs go LO, diodes CR655 through CR658 turn off and CR659 turns on, producing the ECG LEAD CHECK voltage across divider R639, R640, and R641 between -12 volts and ground. Outputs are as follows: RA to LL, 1.5 millivolts; RA to LA, 1 millivolt; LA to LL, 0.5 millivolt.

The duration of the pulse is determined by how long the Q7 output of the counter remains LO (about 32 milliseconds).

Capacitor C691 gives the output pulses the appropriate rise and fall times to activate the QRS detector, but not the pacer detector.

Page 3-19, left column, under the BATTERY CHARGER heading
CHANGE TO READ:
The charging circuit consists of Q712, Q715, and associated circuit components. Charging current is supplied through R715, R716, and Q715. This current is limited to about 560 mA (about 350 mA in older instruments supplies with D-cell battery packs). The voltage developed across R715 and R716 turns on Q712, which diverts current from the base of Q715 and thus regulates the current through Q715.

Page 5-9, left column, following Step A1.d.
ADD: New Step A2 as follows:
A2. CLOCK
 a. Connect test oscilloscope input to TP615 on Main Board. Display 2 kHz square wave.
 b. CHECK - Period of square-wave signal at TP615 is 500 μs.
 c. ADJUST - Clock (R601) so that square-wave period is 500 μs.

Pages 5-9 and 5-10
Increment by one the numbers of previously existing steps A2, A3, A4, and A5.

Page 5-10, right column, following Step A6.d.
ADD: New part e. as follows:
 e. INTERACTION - Occurs between Horiz Position and Horiz Width adjustments. Repeat Steps A6.a. through A6.d as necessary.

Reletter parts e. and f. to f. and g. respectively.

DESCRIPTION

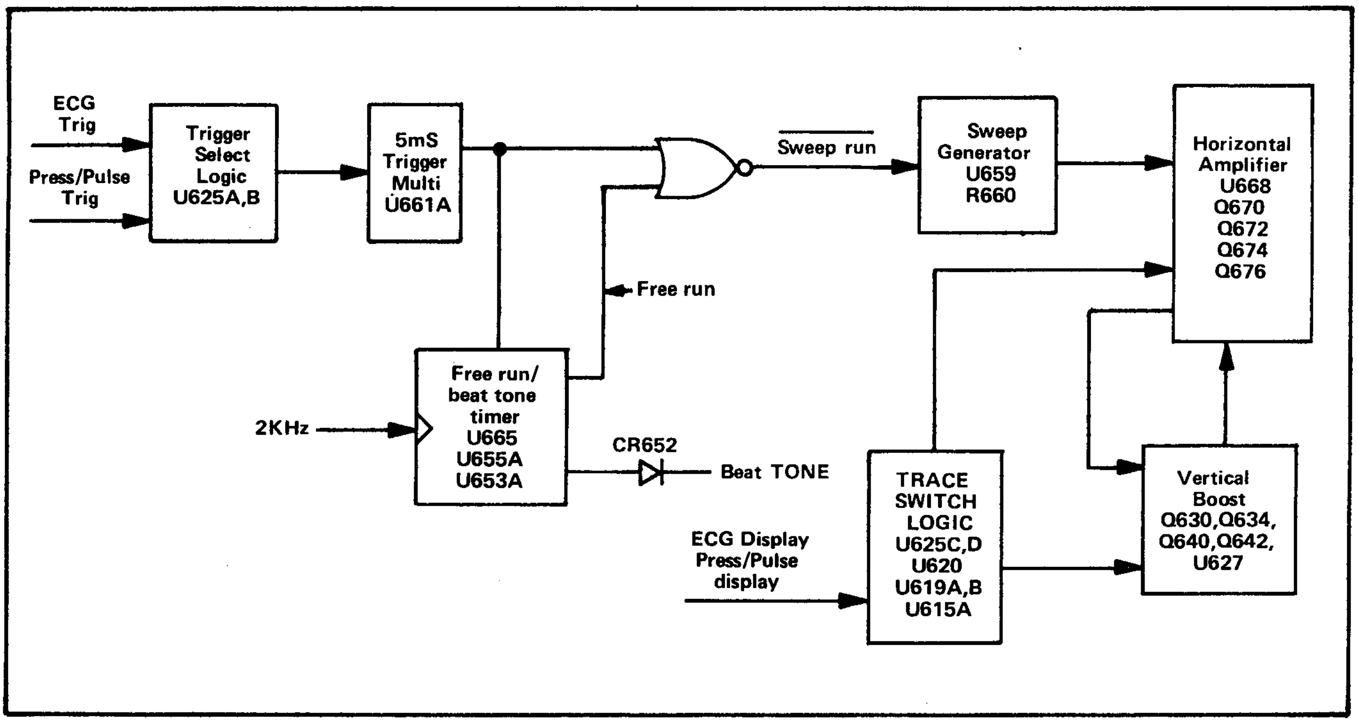


Fig. 3-12. Horizontal circuit block diagram.

Product: 414 SERVICE Date: 8-12-80 Change Reference: M36268

DESCRIPTION

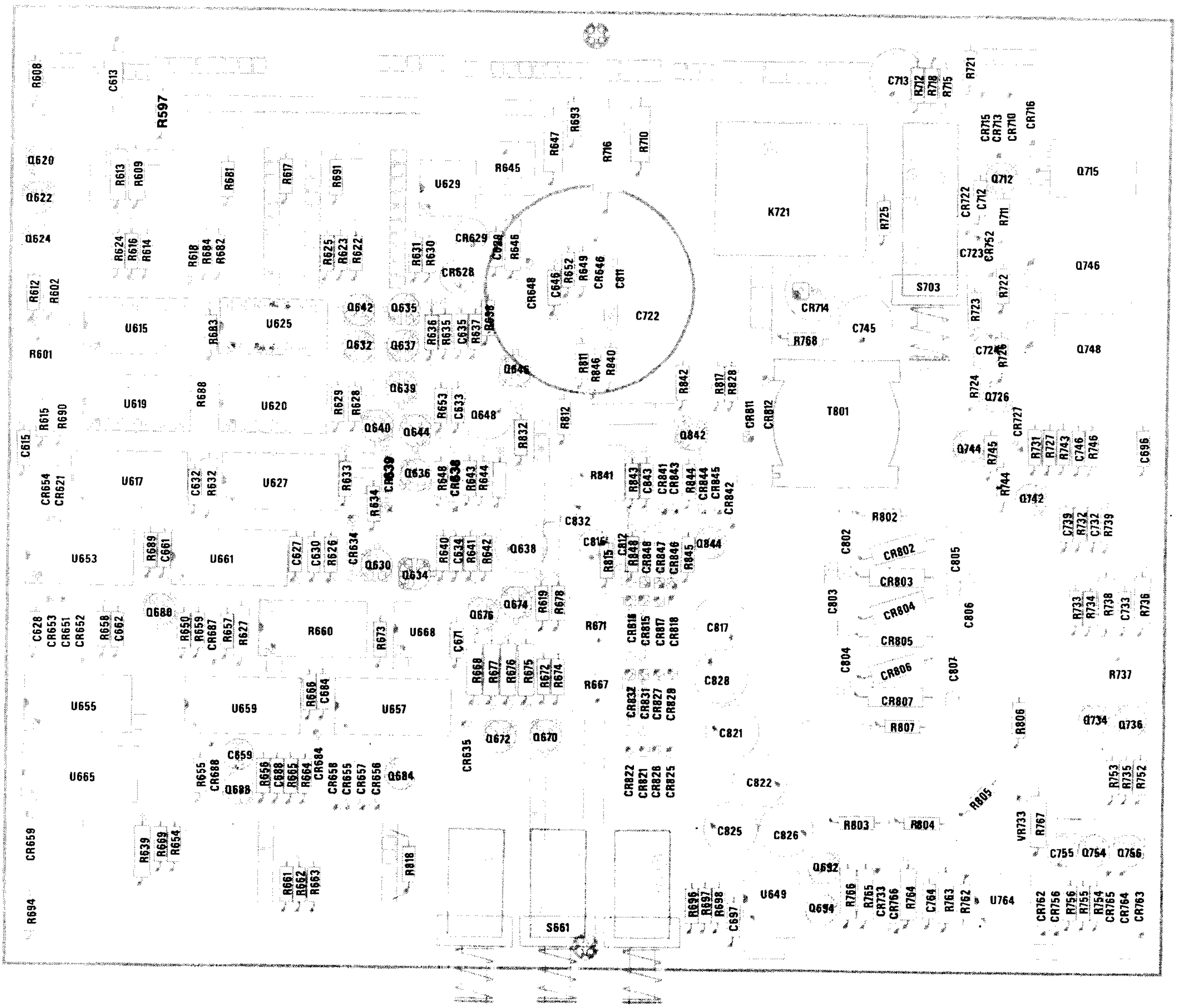
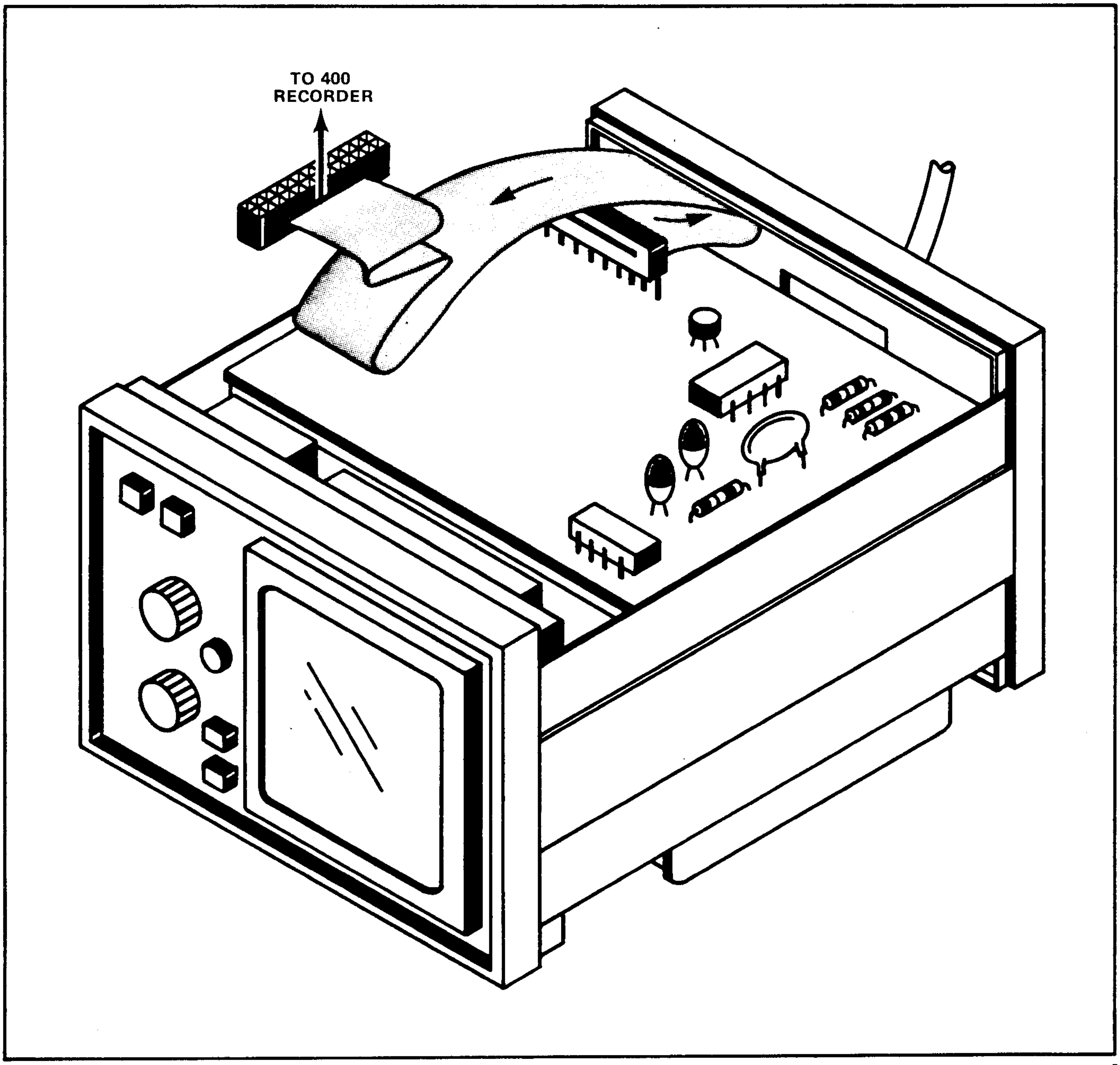


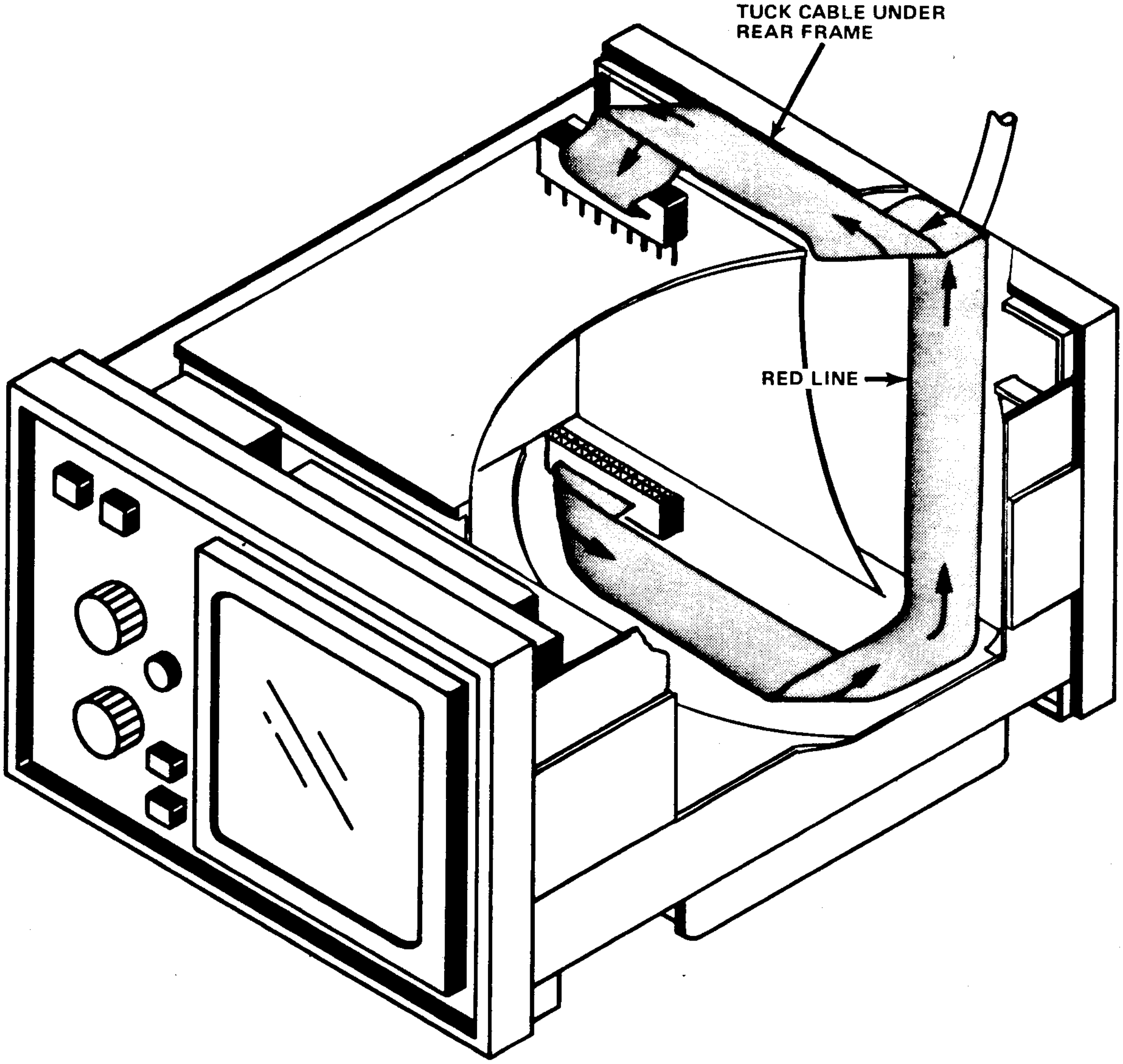
Fig. 8-7. A4 Main board component locations.

DESCRIPTION



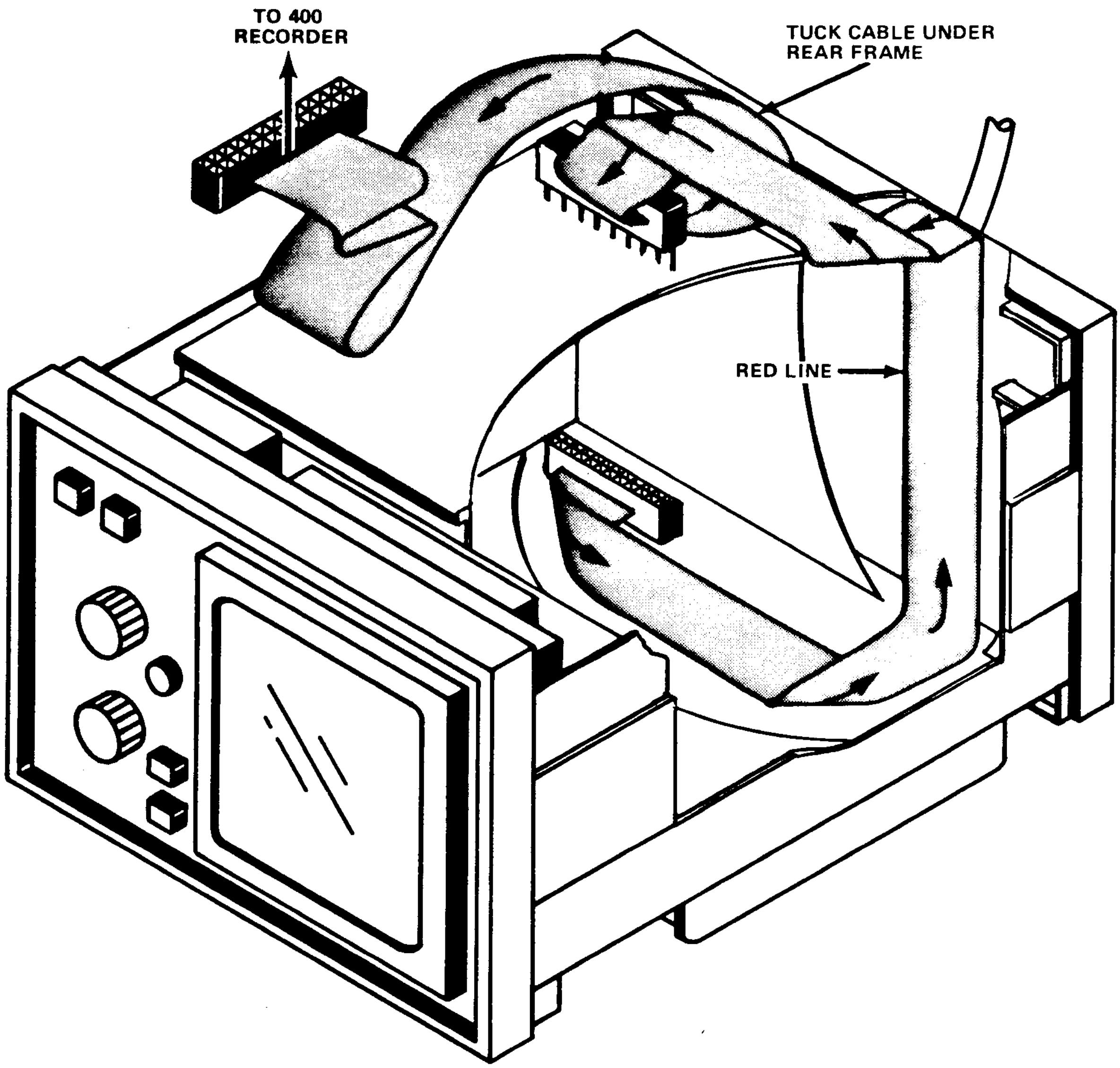
Proper cable dress for 400 Recorder interconnecting cable.

DESCRIPTION

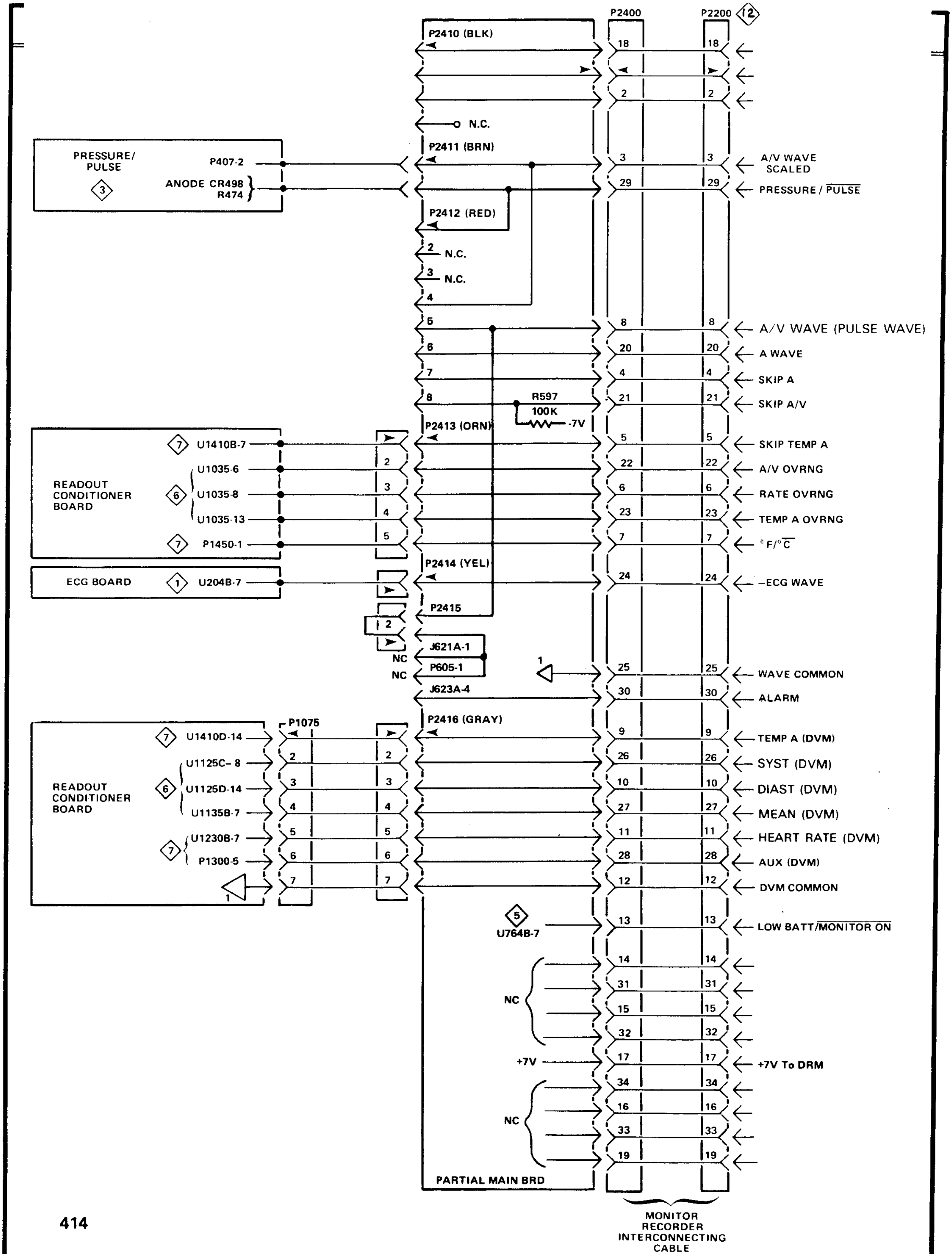


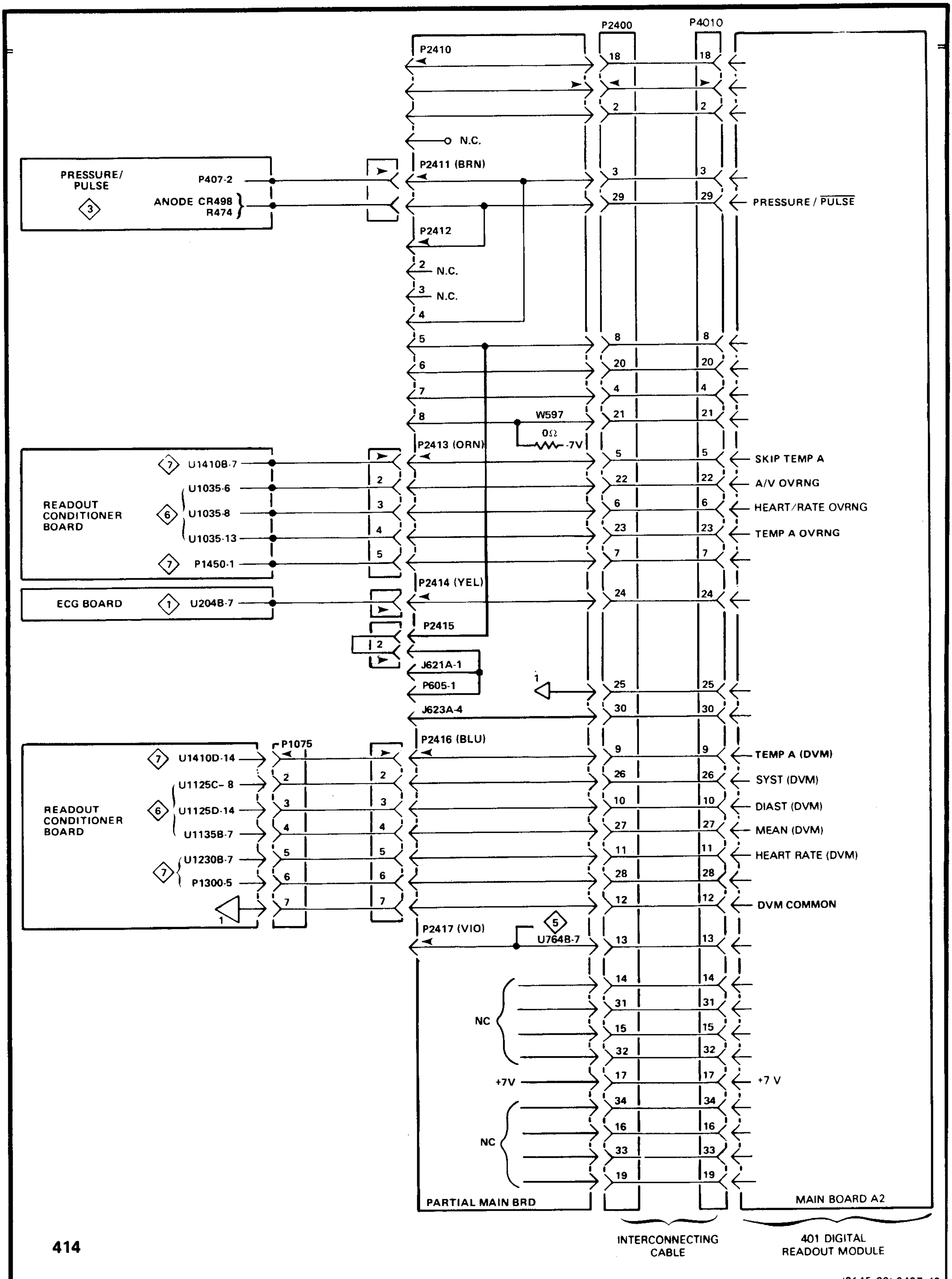
Proper cable dress for 401 Digital Readout Module interconnecting cable.

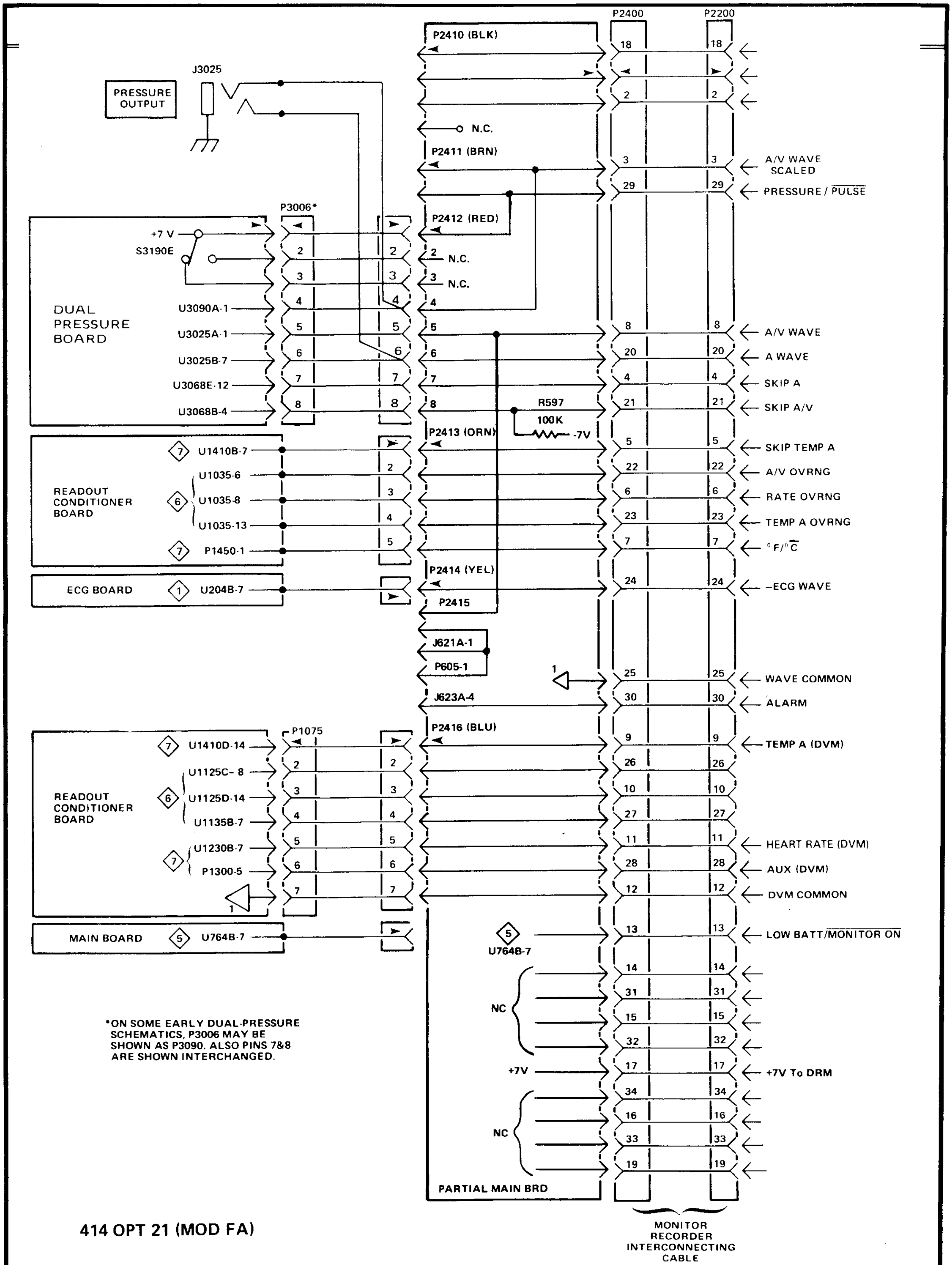
DESCRIPTION



Proper cable dress for 400 Recorder and 401 Digital Readout Module interconnecting cables.

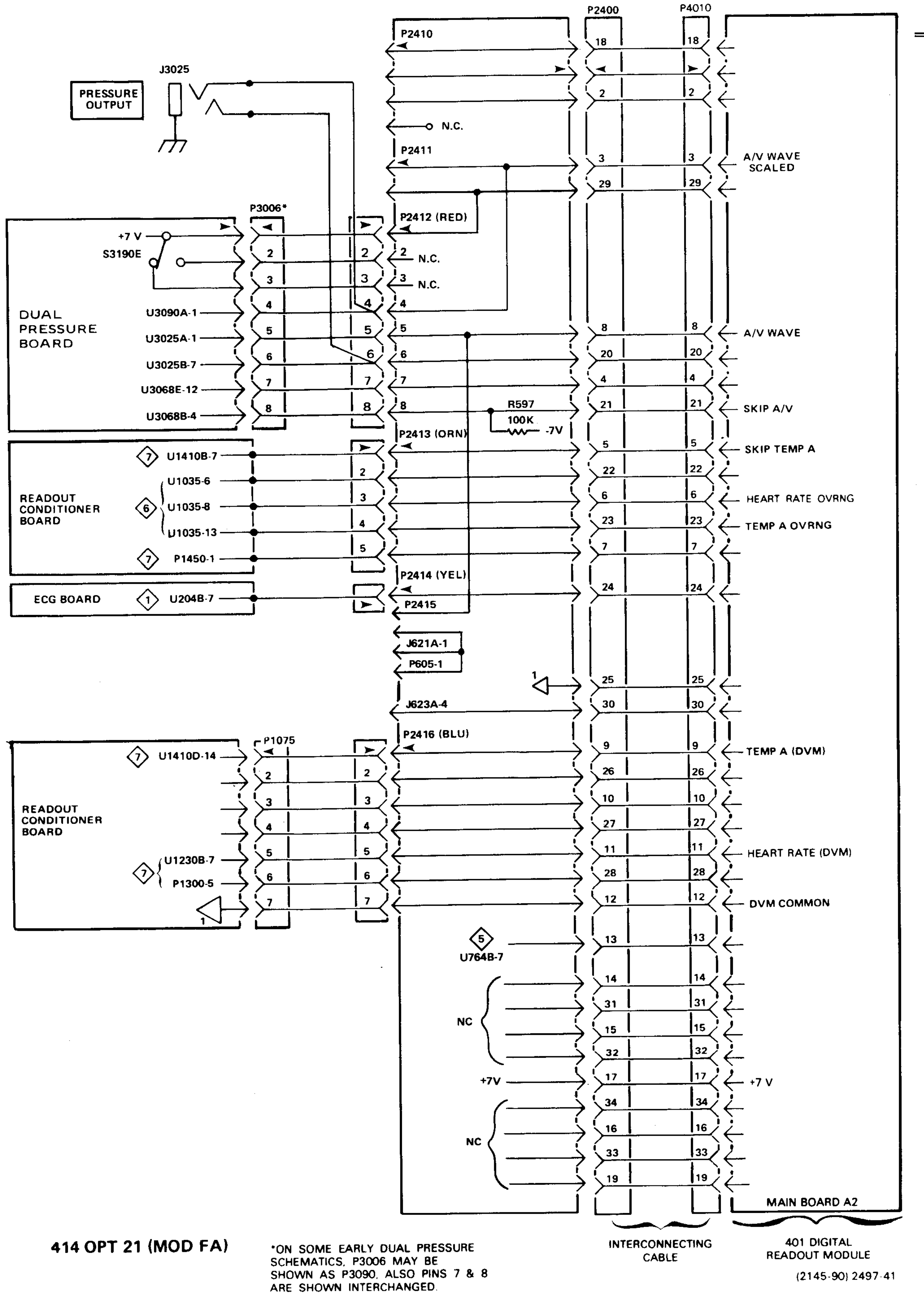

P2400
P2200
P2410 (BLK)
N.C.
P2411 (BRN)
PRESSURE/ PULSE
P407-2
ANODE CR498 R474
P2412 (RED)
A/V WAVE SCALED
PRESSURE / PULSE
A/V WAVE (PULSE WAVE)
A WAVE
SKIP A
SKIP A/V
R597 100K -7V
P2413 (ORN)
SKIP TEMP A
A/V OVRNG
RATE OVRNG
TEMP A OVRNG
°F/°C
READOUT CONDITIONER BOARD
U1410B-7
U1035-6
U1035-8
U1035-13
P1450-1
ECG BOARD
U204B-7
P2414 (YEL)
–ECG WAVE
P2415
J621A-1
P605-1
J623A-4
NC
WAVE COMMON
ALARM
P1075
P2416 (GRAY)
U1410D-14
U1125C- 8
U1125D-14
U1135B-7
U1230B-7
P1300-5
TEMP A (DVM)
SYST (DVM)
DIAST (DVM)
MEAN (DVM)
HEART RATE (DVM)
AUX (DVM)
DVM COMMON
U764B-7
LOW BATT/MONITOR ON
+7V
+7V To DRM
PARTIAL MAIN BRD
MONITOR RECORDER INTERCONNECTING CABLE
(2145-89) 2429-55


P2400
P4010
P2410
N.C.
PRESSURE/ PULSE
P407-2
ANODE CR498
R474
P2411 (BRN)
PRESSURE / PULSE
P2412
W597
0Ω
-7V
P2413 (ORN)
READOUT CONDITIONER BOARD
U1410B-7
U1035-6
U1035-8
U1035-13
P1450-1
SKIP TEMP A
A/V OVRNG
HEART/RATE OVRNG
TEMP A OVRNG
ECG BOARD
U204B-7
P2414 (YEL)
P2415
J621A-1
P605-1
J623A-4
P1075
P2416 (BLU)
U1410D-14
U1125C- 8
U1125D-14
U1135B-7
U1230B-7
P1300-5
TEMP A (DVM)
SYST (DVM)
DIAST (DVM)
MEAN (DVM)
HEART RATE (DVM)
DVM COMMON
P2417 (VIO)
U764B-7
NC
+7V
+7 V
PARTIAL MAIN BRD
MAIN BOARD A2
INTERCONNECTING CABLE
401 DIGITAL READOUT MODULE



414 OPT 21 (MOD FA)

2145-90



414 OPT 21 (MOD FA)

*ON SOME EARLY DUAL PRESSURE SCHEMATICS, P3006 MAY BE SHOWN AS P3090. ALSO PINS 7 & 8 ARE SHOWN INTERCHANGED.

Product: 414 SERVICE Date: 8-12-80 Change Reference: M36268

DESCRIPTION

REPLACEABLE ELECTRICAL PARTS AND SCHEMATIC CHANGES

CHANGE TO:

A4	670-6395-00	CKT BOARD ASSY:MAIN (REPLACES 670-4357-XX)
L840A,B	119-0950-00	COIL,TUBE DEFL:CRT YOKE
LS691	119-0716-03	LOUDSPEAKER,PM:WITH CABLE
M763	149-0043-02	METER,BTRY LVL:W/BRACKET,HOLDER & CONN.
R598	321-0030-00	RES.,FXD,FILM:20 OHM,1%,0.125W
R599	321-0001-00	RES.,FXD,FILM:10 OHM,1%,0.125W

The new MAIN circuit board asembly 670-6395-00 consists of the following:

C613	285-0627-00	CAP.,FXD,PLASTIC:0.0033UF,5%,100V
C615	281-0814-00	CAP.,FXD,CER DI:100PF,10%,100V
C627	281-0826-00	CAP.,FXD,CER DI:2200PF,5%,100V
C628	281-0812-00	CAP.,FXD,CER DI:0.001UF,10%,100V
C629	281-0788-00	CAP.,FXD,CER DI:470PF,10%,100V
C630	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C632	281-0826-00	CAP.,FXD,CER DI:2200PF,5%,100V
C633	281-0788-00	CAP.,FXD,CER DI:470PF,10%,100V
C634	281-0772-00	CAP.,FXD,CER DI:4700PF,10%,100V
C635	281-0812-00	CAP.,FXD,CER DI:0.001UF,10%,100V
C646	281-0772-00	CAP.,FXD,CER DI:4700PF,10%,100V
C659	290-0536-01	CAP.,FXD,ELCTLT:10UF,20%,25V
C661	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
C662	281-0815-00	CAP.,FXD,CER DI:0.027UF,20%,50V
C671	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C684	281-0763-00	CAP.,FXD,CER DI:47PF,10%k100V
C688	281-0763-00	CAP.,FXD,CER DI:47PF,10%,100V
C691	290-0722-01	CAP.,FXD, ELCTLT:100UF,20%,10V
C696	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
C697	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
C712	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C713	290-0722-01	CAP.,FXD,ELCTLT:100UF,20%,10V
C722	290-0851-00	CAP.,FXD,ELCTLT:10,000UF, +100-10%,15V
C723	290-0536-01	CAP.,FXD,ELCTLT:10UF,20%,25V
C724	290-0536-01	CAP.,FXD,ELCTLT:10UF,20%,25V
C732	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C733	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V

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DESCRIPTION		
C739	281-0773-00	CAP.,FXD,CER DI:0.01UF,10%,100V
C745	290-0722-01	CAP.,FXD,ELCTLT:100UF,20%,10V
C746	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C755	290-0536-01	CAP.,FXD,ELCTLT:10UF,20%,25V
C764	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C802	283-0280-00	CAP.,FXD,CER DI:2200PF,10%,2000V
C803	283-0280-00	CAP.,FXD,CER DI:2200PF,10%,2000V
C804	283-0280-00	CAP.,FXD,CER DI:2200PF,10%,2000V
C805	283-0280-00	CAP.,FXD,CER DI:2200PF,10%,2000V
C806	283-0280-00	CAP.,FXD,CER DI:2200PF,10%,2000V
C807	283-0280-00	CAP.,FXD,CER DI:2200PF,10%,2000V
C811	283-0006-00	CAP.,FXD,CER DI:0.02UF,+80-20%,500V
C812	283-0006-00	CAP.,FXD,CER DI:0.02UF,+80-20%,500V
C815	290-0525-00	CAP.,FXD,ELCTLT:4.7UF,20%,50V
C817	290-0721-01	CAP.,FXD,ELCTLT:100UF,20%,20V
C821	290-0726-01	CAP.,FXD,ELCTLT:220UF,20%,10V
C822	290-0726-01	CAP.,FXD,ELCTLT:220UF,20%,10V
C825	290-0726-01	CAP.,FXD,ELCTLT:220UF,20%,10V
C826	290-0726-01	CAP.,FXD,ELCTLT:220UF,20%,10V
C828	290-0721-01	CAP.,FXD,ELCTLT:100UF,20%,20V
C832	290-0525-00	CAP.,FXD,ELCTLT:4.7UF,20%,50V
C843	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
CR596	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR621	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR634	152-0107-03	SEMICOND DEVICE:SILICON,RECT.,400V,400MA,G727
CR635	152-0107-03	SEMICOND DEVICE:SILICON,RECT.,400V,400MA,G727
CR638	152-0107-03	SEMICOND DEVICE:SILICON,RECT.,400V,400MA,G727
CR639	152-0107-03	SEMICOND DEVICE:SILICON,RECT.,400V,400MA,G727

DESCRIPTION

CR646	152-0107-03	SEMICOND DEVICE:SILICON,RECT.,400V,400MA,G727
CR648	152-0107-03	SEMICOND DEVICE:SILICON,RECT.,400V,400MA,G727
CR651	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR652	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR653	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR654	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR655	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR656	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR657	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR658	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR659	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR684	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR687	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR688	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR710	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR713	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR714	152-0423-00	SEMICOND DEVICE:SILICON,400V,3A
CR715	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR716	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR722	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR727	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR733	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR752	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR756	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR762	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR763	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR764	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR765	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152

DESCRIPTION

CR766	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR802	152-0170-00	SEMICOND DEVICE:SILICON,1500V,25MA,1N4441
CR803	152-0170-00	SEMICOND DEVICE:SILICON,1500V,25MA,1N4441
CR804	152-0170-00	SEMICOND DEVICE:SILICON,1500V,25MA,1N4441
CR805	152-0170-00	SEMICOND DEVICE:SILICON,1500V,25MA,1N4441
CR806	152-0170-00	SEMICOND DEVICE:SILICON,1500V,25MA,1N4441
CR807	152-0170-00	SEMICOND DEVICE:SILICON,1500V,25MA,1N4441
CR811	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR812	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR815	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR816	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR817	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR818	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR821	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR822	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR825	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR826	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR827	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR828	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR831	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR832	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA,G727
CR841	152-0066-00	SEMICOND DEVICE:SILICON,400V,750MA
CR842	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR843	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR844	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR845	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR846	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
CR847	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152

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DESCRIPTION

CR848	152-0141-02	SEMICOND DEVICE:SILICON,30V,150MA,1N4152
DS628	150-1031-00	LIGHT EMITTING DIODE:RED,650NM,40MA,MAX
DS629	150-1031-00	LIGHT EMITTING DIODE:RED,650NM,40MA,MAX
K721	148-0112-00	RELAY,ARMATURE:SPDT,6VDC,5A
Q620	151-0190-00	TRANSISTOR:SILICON,NPN,2N3904
Q622	151-0190-00	TRANSISTOR:SILICON,NPN,2N3904
Q624	151-0188-00	TRANSISTOR:SILICON,PNP, 2N3906
Q630	151-0347-00	TRANSISTOR:SILICON,NPN,2N5551
Q632	151-0347-00	TRANSISTOR:SILICON,NPN
Q634	151-0301-00	TRANSISTOR:SILICON,PNP,2N2907A
Q635	151-0190-00	TRANSISTOR:SILICON,NPN,2N3904
Q636	151-0350-00	TRANSISTOR:SILICON,PNP
Q637	151-0190-00	TRANSISTOR:SILICON,NPN,2N3904
Q638	151-0407-00	TRANSISTOR:SILICON,NPN
Q639	151-0188-00	TRANSISTOR:SILICON,PNP
Q640	151-0350-00	TRANSISTOR:SILICON,PNP
Q642	151-0350-00	TRANSISTOR:SILICON,PNP
Q644	151-0302-00	TRANSISTOR:SILICON,NPN,2N2222A
Q646	151-0347-00	TRANSISTOR:SILICON,NPN
Q648	151-0406-00	TRANSISTOR:SILICON,PNP
Q670	151-0190-00	TRANSISTOR:SILICON,NPN
Q672	151-0188-00	TRANSISTOR:SILICON,PNP
Q674	151-0190-00	TRANSISTOR:SILICON,NPN
Q676	151-0188-00	TRANSISTOR:SILICON,PNP
Q680	151-0190-00	TRANSISTOR:SILICON,NPN
Q684	151-0188-00	TRANSISTOR:SILICON,PNP
Q688	151-0188-00	TRANSISTOR:SILICON,PNP

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DESCRIPTION		
Q692	151-0190-00	TRANSISTOR:SILICON,NPN
Q694	151-0188-00	TRANSISTOR:SILICON,PNP
Q712	151-0188-00	TRANSISTOR:SILICON,PNP
Q715	151-0657-00	TRANSISTOR:SILICON,PNP,SJE1973,DARLINGTON
Q726	151-0188-00	TRANSISTOR:SILICON,PNP
Q734	151-0190-00	TRANSISTOR:SILICON,NPN
Q736	151-0190-00	TRANSISTOR:SILICON,NPN
Q742	151-0190-00	TRANSISTOR:SILICON,NPN
Q744	151-0188-00	TRANSISTOR:SILICON,PNP
Q746	151-0349-00	TRANSISTOR:SILICON,NPN,SEL FROM MJE2801
Q748	151-0349-00	TRANSISTOR:SILICON,NPN,SEL FROM MJE2801
Q754	151-0190-00	TRANSISTOR:SILICON,NPN
Q756	151-0190-00	TRANSISTOR:SILICON,NPN
Q842	151-0350-00	TRANSISTOR:SILICON,PNP
Q844	151-0188-00	TRANSISTOR:SILICON,PNP
R596	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R597	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R601	311-1226-00	RES.,VAR,NONWW:2.5K OHM,20%,0.50W
R602	321-0297-00	RES.,FXD,FILM:12.1K OHM,1%,0.125W
R608	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R609	321-0366-00	RES.,FXD,FILM:63.4K OHM,1%,0.125W
R612	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R613	321-0373-00	RES.,FXD,FILM:75K OHM,1%,0.125W
R614	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R615	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R616	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R617	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R618	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R619	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W

Product: 414 SERVICE Date: 8-12-80 Change Reference: M36268

DESCRIPTION

R622	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R623	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R624	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R625	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R626	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R627	321-0275-00	RES.,FXD,FILM:7.15K OHM,1%,0.125W
R628	315-0202-00	RES.,FXD,CMPSN:2K OHM,5%,0.25W
R629	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R630	315-0472-00	RES.,FXD,CMSPN:4.7K OHM,5%,0.25W
R631	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R632	321-0335-00	RES.,FXD,FILM:30.1K OHM,1%,0.125W
R633	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R634	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
R635	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R636	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R637	315-0471-00	RES.,FXD,CMPSN:470 OHM,5%,0.25W
R638	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R639	321-0420-00	RES.,FXD,FILM:232K OHM,1%,0.125W
R640	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R641	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R642	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R643	315-0330-00	RES.,FXD,CMPSN:33 OHM,5%,0.25W
R644	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R645	311-1222-00	RES.,VAR,NONWIR:100 OHM,20%,0.50W
R646	321-0142-00	RES.,FXD,FILM:294 OHM,1%,0.125W
R647	308-0574-00	RES.,FXD,WW:10 OHM,5%,2W
R648	315-0330-00	RES.,FXD,CMPSN:33 OHM,5%,0.25W

Product: 414 SERVICE Date: 8-12-80 Change Reference: M36268

DESCRIPTION

R649	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R650	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W
R652	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R653	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R654	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R655	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W
R656	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R657	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R658	315-0754-00	RES.,FXD,CMPSN:750K OHM,5%,0.25W
R659	315-0393-00	RES.,FXD,CMPSN:39K OHM,5%,0.25W
R660	307-0573-00	RES.,NETWORK,FXD,FI:(9)100K, (11) 200K, 2%,0.05W
R662	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R663	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R664	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W
R665	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R666	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R667	311-1231-00	RES.,VAR,NONWIR:25K OHM,20%,0.50W
R668	321-0352-00	RES.,FXD,FILM:45.3K OHM,1%,0.125W
R669	315-0105-00	RES.,FXD,CMPSN:1 M OHM,5%,0.25W
R671	311-1228-00	RES.,VAR,NONWIR:10K OHM,20%,0.50W
R672	315-0913-00	RES.,FXD,CMPSN:91K OHM,5%,0.25W
R673	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R674	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R675	321-0363-00	RES.,FXD,FILM:59K OHM,1%,0.125W
R676	321-0365-00	RES.,FXD,FILM:61.9K OHM,1%,0.125W
R677	321-0385-00	RES.,FXD,FILM:100K OHM,1%,0.125W

DESCRIPTION

R678	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R681	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R682	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R683	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R684	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R688	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R689	315-0474-00	RES.,FXD,CMPSN:470K OHM,5%,0.25W
R690	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R691	315-0105-00	RES.,FXD,CMPSN:1 M OHM,5%,0.25W
R693	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R694	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R696	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R697	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R698	315-0154-00	RES.,FXD,CMPSN:150K OHM,5%,0.25W
R710	301-0360-00	RES.,FXD,CMPSN:36 OHM,5%,0.50W
R711	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
R712	315-0471-00	RES.,FXD,CMPSN:470 OHM,5%,0.25W
R715	307-0114-00	RES.,FXD,CMPSN:6.2 OHM,5%,0.25W
R716	308-0365-00	RES.,FXD,WW:1.5 OHM,5%,3W
R718	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
R721	317-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.125W
R722	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
R723	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
R724	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R725	315-0101-00	RES.,FXD,CMPSN:100 OHM,5%,0.25W
R726	315-0333-00	RES.,FXD,CMPSN:33K OHM,5%,0.25W
R727	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W

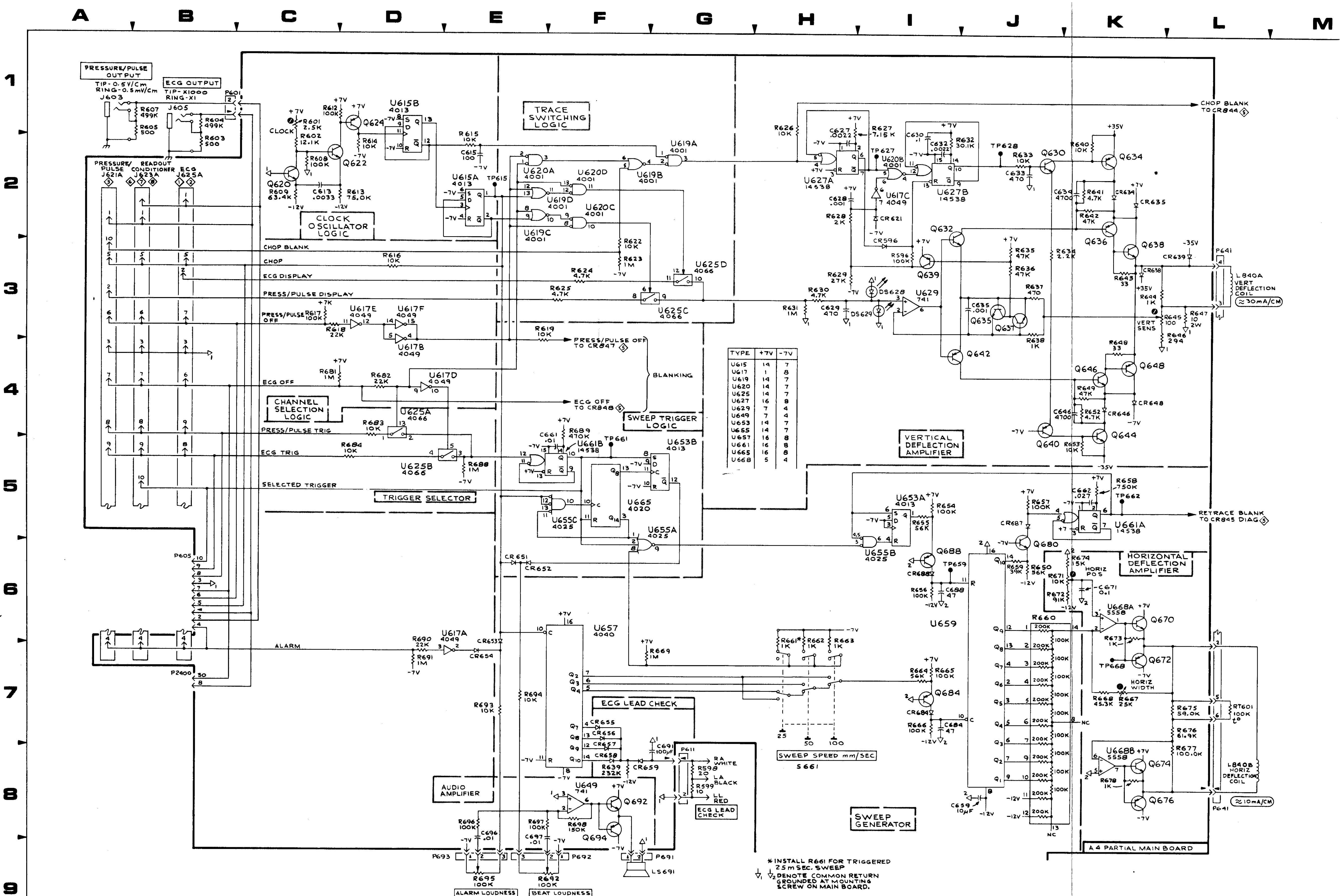
Product: 414 SERVICE Date: 8-12-80 Change Reference: M36268

DESCRIPTION		
R731	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
R732	315-0152-00	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W
R733	315-0821-00	RES.,FXD,CMPSN:820 OHM,5%,0.25W
R734	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R735	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
R736	321-0333-00	RES.,FXD,FILM:28.7K OHM,1%,0.125W
R737	311-1227-00	RES.,VAR,NONWIR:5K OHM,20%,0.50W
R738	321-0330-00	RES.,FXD,FILM:26.7K OHM,1%,0.125W
R739	315-0240-00	RES.,FXD,CMPSN:24 OHM,5%,0.25W
R743	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R744	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R745	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R746	315-0330-00	RES.,FXD,CMPSN:33 OHM,5%,0.25W
R752	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R753	315-0222-00	RES.,FXD,CMPSN:2.2K OHM,5%,0.25W
R754	315-0683-00	RES.,FXD,CMPSN:68K OHM,5%,0.25W
R755	315-0333-00	RES.,FXD,CMPSN:33 K OHM,5%,0.25W
R756	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R762	315-0273-00	RES.,FXD,CMPSN:27K OHM,5%,0.25W
R763	321-0210-00	RES.,FXD,FILM: 1.50K OHM,1%,0.125W
R764	321-0408-00	RES.,FXD,FILM: 174K OHM,1%,0.125W
R765	321-0363-00	RES.,FXD,FILM:59K OHM,1%,0.125W
R766	321-0365-00	RES.,FXD,FILM:61.9K OHM,1%,0.125W
R767	321-0775-00	RES.,FXD,FILM:45K OHM,1%,0.125W
R768	315-0301-00	RES.,FXD,CMPSN:300 OHM,5%,0.25W
R802	315-0683-00	RES.,FXD,CMPSN:68K OHM,5%,0.25W
R803	315-0225-00	RES.,FXD,CMPSN:2.2M OHM,10%,0.25W

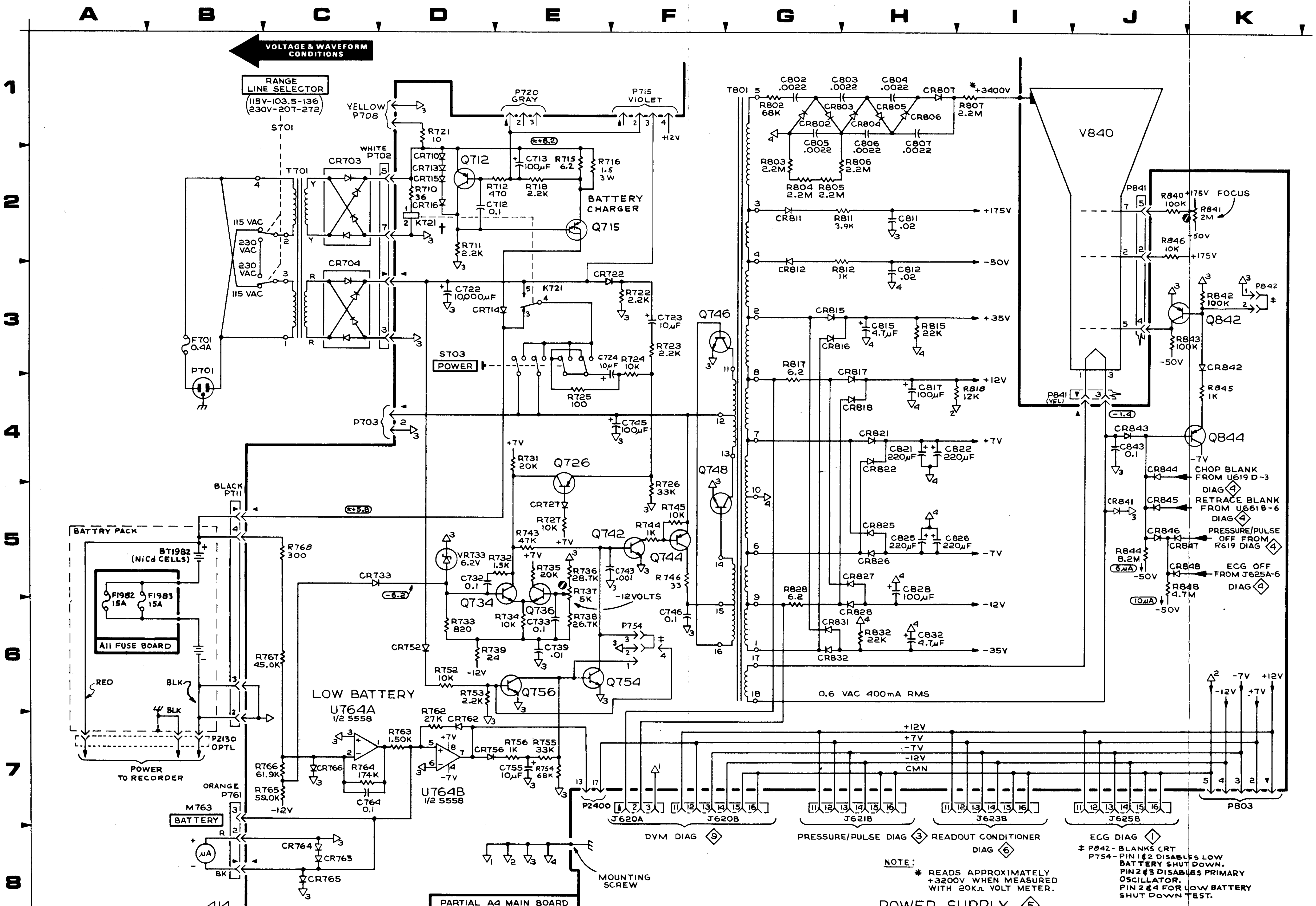
		DESCRIPTION
R804	315-0225-00	RES.,FXD,CMPSN:2.2M OHM,10%,0.25W
R805	315-0225-00	RES.,FXD,CMPSN:2.2M OHM,10%,0.25W
R806	315-0225-00	RES.,FXD,CMPSN:2.2M OHM,10%,0.25W
R807	315-0225-00	RES.,FXD,CMPSN:2.2M OHM,10%,0.25W
R811	315-0392-00	RES.,FXD,CMPSN:3.9K OHM,5%,0.25W
R812	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R815	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R817	307-0114-00	RES.,FXD,CMPSN:6.2 OHM,5%,0.25W
R818	315-0123-00	RES.,FXD,CMPSN:12K OHM,5%,0.25W
R828	307-0114-00	RES.,FXD,CMPSN:6.2 OHM,5%,0.25W
R832	315-0223-00	RES.,FXD,CMPSN:22K OHM,5%,0.25W
R840	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R841	311-1255-00	RES.,VAR,NONWIR:2M OHM,20%,0.50W
R842	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R843	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R844	316-0825-00	RES.,FXD,CMPSN:8.2M OHM,10%,0.25W
R845	315-0102-00	RES.,FXD,CMPSN:1K OHM,5%,0.25W
R846	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R848	315-0475-00	RES.,FXD,CMPSN:4.7M OHM,5%,0.25W
S661	260-1572-01	SWITCH,PUSH:3 BTN,2 POLE,SWEEP SPEED
S703	260-1486-00	SWITCH,PUSH:
T801	120-0868-00	XFMR,INVERTER:POT CORE
U615	156-0366-02	MICROCIRCUIT,DI:DUAL D FLIP-FLOP,SCREENED
U617	156-0494-02	MICROCIRCUIT,DI:HEX INV/BUSS,SEL,4049
U619	156-0349-03	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL

DESCRIPTION

U620	156-0349-03	MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE,SEL
U625	156-0644-00	MICROCIRCUIT,DI:QUAD BILATERAL SW. CD4066AE
U627	156-1152-00	MICROCIRCUIT,DI:DUAL PRCN RETRIGGERABLE,RESETTABLE, MONOSTABLE,MULTIVIBRATOR,4538,CMOS
U629	156-0067-12	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER
U649	156-0067-12	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER
U653	156-0366-02	MICROCIRCUIT,DI:DUAL D FLIP-FLOP,SCREENED
U655	156-0575-03	MICROCIRCUIT,DI:3 INPUT NOR GATE,SEL,4025
U657	156-0545-01	MICROCIRCUIT,DI:12 BIT BINARY CNTR,SCREENED
U659	156-0545-01	MICROCIRCUIT,DI:12 BIT BINARY CNTR,SCREENED
U661	156-1152-00	MICROCIRCUIT,DI:DUAL PRCN RETRIGGERABLE,RESETTABLE, MONISTABLE,MULTIVIBRATOR,4538,CMOS
U665	156-0895-00	MICROCIRCUIT,DI:14-BIT BINARY COUNTER,14020,CMOS
U668	156-0158-03	MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK
U764	156-0158-03	MICROCIRCUIT,LI:DUAL OPNL AMPL,CHK
VR733	152-0461-00	SEMICOND DEVICE:ZENER,0.4W,6.2V,5%,IN821



TYPE	+7V	-7V
U615	14	7
U617	1	8
U619	14	7
U620	14	7
U625	14	7
U627	16	8
U629	7	4
U649	7	4
U653	14	7
U655	14	7
U657	16	8
U661	16	8
U665	16	8
U668	5	4



POWER SUPPLY 5

M36268

Tektronix
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 1-2-80 Change Reference: C13/180

Product: 408, 412, 413 and 414 Manual Part No.: see below

DESCRIPTION

408 (070-1525-00) Page 4-6

412 (070-1523-00) Page 4-7

413 (070-2277-00) Page 4-9 (Remove existing instructions)

414 (070-2042-00) Page 4-8

TEXT ADDITION

ADD:

Replacing Battery Fuses

1. Remove the top and bottom covers from the instrument.
2. Turn the instrument upside down and unplug the ribbon cable that connects the battery pack to the main circuit board.
3. Turn the instrument over and remove the two flat-head screws that hold the battery pack in the instrument.
4. Remove the four nuts that hold the cover on the battery pack. Do not loosen or remove the nut that holds the ground lead to the battery pack cover.
5. Fold back the fishpaper that covers the cells to expose the circuit board that mounts the fuses between the ends of the two center cells.
6. Using a low-wattage soldering iron, unsolder and remove the defective fuses.
7. Remove the solder from the holes in the circuit board using a desoldering tool, a solder wick, or a sharp toothpick.

CAUTION

> Excess heat can damage fuses. Use low-wattage soldering iron and apply only enough heat to make the solder flow properly.

8. Bend the leads on the new fuses to the proper shape, insert the leads into the holes in the circuit board, and solder. Trim the excess length from the fuse leads.
9. Carefully fold the fishpaper back to its original shape and position over the cells, replace the cover on the battery pack, replace the nuts on the studs, and reinstall the battery pack in the instrument.
10. Reconnect the ribbon cable onto the main board. Plug orientation is not important.

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MANUAL CHANGE INFORMATION

Date: 8-25-80 Change Reference: M41398

Product: 408 and 414 SERVICE Manual Part No.: see below

DESCRIPTION

EFF SN B203715 (408) 070-1525-00

EFF SN B097215 (414) 070-2042-01

REPLACEABLE ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

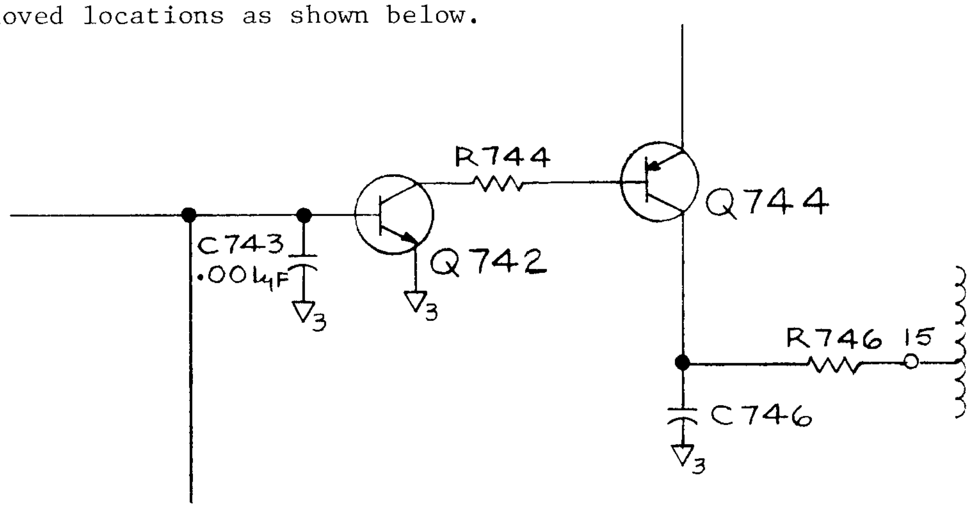
A3	670-6758-01	CKT BOARD ASSY:MAIN (408 ONLY)
C732	283-0177-00	CAP.,FXD,CER DI:1UF,+80-20%,25V

ADD:

C743	281-0812-00	CAP.,FXD,CER DI:0.001UF,10%,100V

DIAGRAM ⟨5⟩ POWER SUPPLY - Partial

R746 moved locations as shown below.



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MANUAL CHANGE INFORMATION

Date: 1-21-81 Change Reference: M38650

Product: 414 Portable PATIENT MONITOR Manual Part No.: 070-2042-01

DESCRIPTION

EFF SN B100000-UP

DVM BOARD 9 (B100000 and up)

Circuit Functions

1. Converts analog input signals from the Conditioner board to digital signals that drive the gas-discharge readout elements.

2. Provides digital signals to blank the digital display during certain intervals that could give an incorrect or unusable display.

3. Suppresses leading zeros.

4. Provides drive for decimal point and sign displays.

5. Provides indication of parameter displayed (rate, pressure, and °C or °F temperature).

6. Provides power supplies for the DVM and gas-discharge readout elements.

DVM And Display Circuit Operation

The basic DVM (digital voltmeter) circuit is composed of U2322, U2345, and associated circuitry (see DVM circuit diagram). Integrated circuit U2322 is a dual-ramp A/D Converter containing digital logic circuitry that integrates, counts, and multiplexes. It also contains analog circuitry that provides operational amplifiers and comparators. Integrated circuit U2345 is a decoder-driver that converts the binary-coded-decimal (BCD) information (from A/D converter U2322) to the form necessary to drive the cathode segments of the gas-discharge display. The remaining circuits provide overrange-flash blanking, inter-digit blanking, leading-zero suppression, and display drive operation.

A/D Converter.
Integrated circuit U2322 is basically an A/D ratiometric converter that measures an unknown input voltage (V_X) at pin 3 as a ratio of the reference voltage (V_{ref}) at pin 2. The full scale voltage is equal to V_{ref}). Thus, a full-scale voltage of 1.999 volts requires a reference voltage of 2.000 volts.

MSD TRUTH TABLE

Coded Condition of MSD	Q3 [b]	Q2 [a]	Q1	Q0
+0	1	1	1	0
-0	1	0	1	0
+1	0	1	0	0
-1	0	0	0	0

[a] Q2 is the sign bit: 1 = (+), 0 = (−)
[b] Q3 is the (1) digit bit: 1 = (1) displayed, 0 = (1) not displayed.

During each conversion cycle, the offset voltages of the internal amplifiers and comparators are compensated for by the system auto-zero operation. The conversion cycle requires slightly more than 16,000 clock periods, which can be divided into six segments. The conversion cycle waveform at pin 6 is shown in Fig. 3-15. The six segments of this waveform are described as follows:

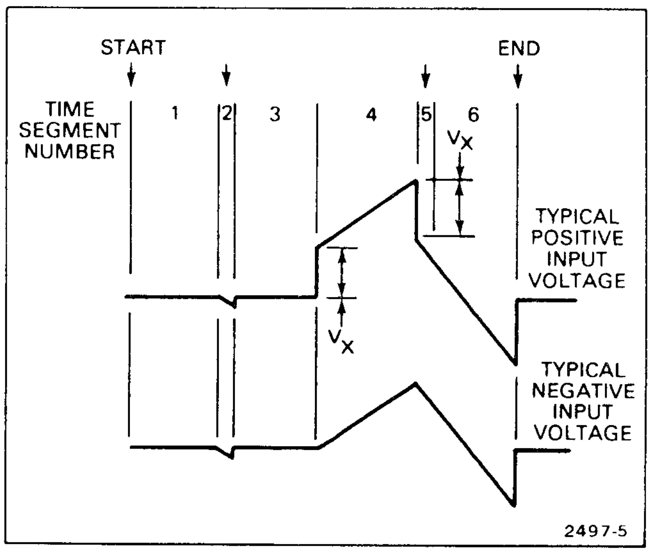


Figure 3-15. Integrator waveform at pin 6 of U2322.

DESCRIPTION

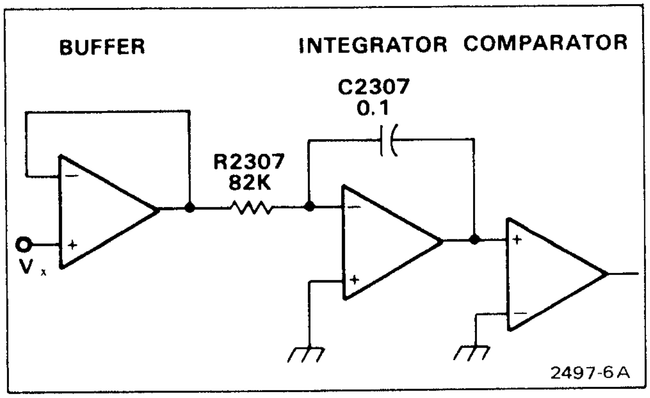


Figure 3-16. Equivalent circuit diagram of the analog section of U2322 during Segment 4.

Segment 1. Offset capacitor C2308 (C_O), which compensates for the input offset voltages of the buffer and integrator amplifiers, is charged during this period. Also, the integrator capacitor is shorted. This segment requires 4000 clock periods.

Segment 2. The integrator output decreases to the comparator threshold voltage. At this time a number of counts equivalent to the input offset voltage of the comparator is stored in the offset latches for later use in the auto-zero process. The time for this segment is variable and less than 800 clock periods.

Segment 3. This segment of the conversion cycle is the same as segment 1.

Segment 4. Segment 4 is an up-going ramp cycle with the unknown input voltage (V_X) at pin 3 as the input to the integrator. Fig. 3-16 shows the equivalent configuration of the analog section of U2322. The actual configuration of the analog section is dependent upon the polarity of the input voltage during the previous conversion cycle.

Segment 5. This segment is a down-going ramp period with V_{ref} as the input to the integrator. Segment 5 of the conversion cycle has a time equal to the number of counts stored in the offset storage latches during segment 2. As a result, the system zeros automatically.

Segment 6. This is an extension of segment 5. The time period for this portion is 4000 clock periods. The results of the A/D conversion cycle are determined in this portion of the conversion cycle.
An end-of-conversion (EOC) pulse is available at pin 14 of U2322 after each conversion cycle. The EOC pulse width is equivalent to one-half the period of the system clock at pin 11 (CLK_O).

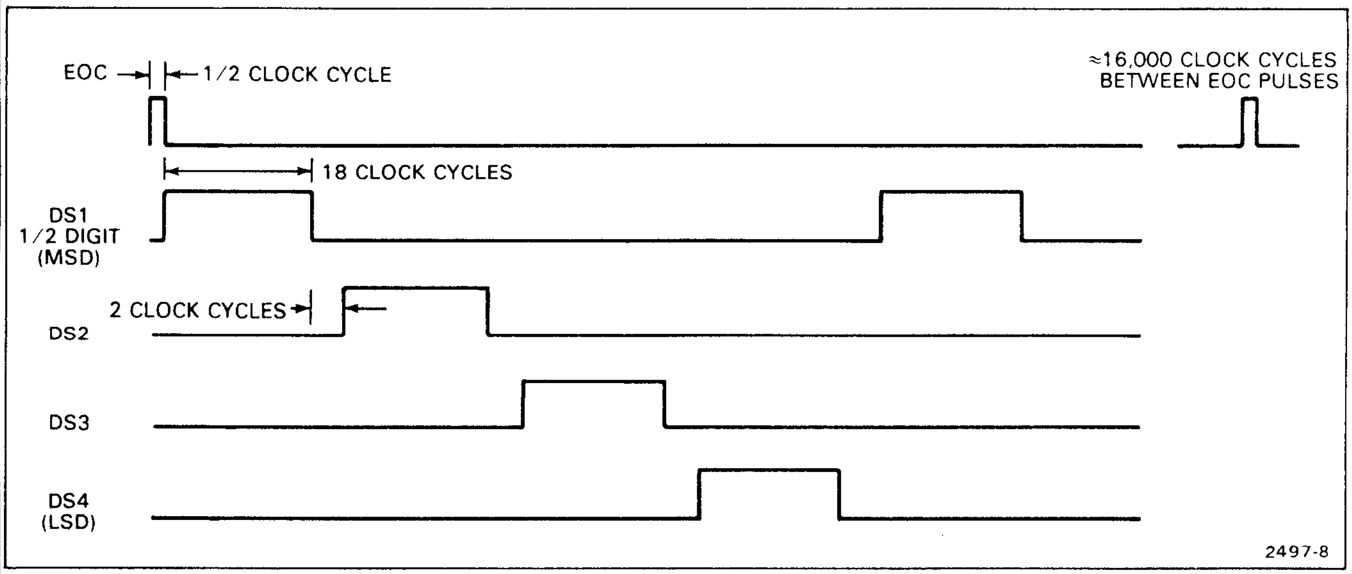


Figure 3-17. Digital select timing diagram.

DESCRIPTION

The results of a conversion cycle will be stored in the output latches, if a display update pulse is applied to pin 9 prior to segment 5. The resulting information stored in the latches is multiplexed out through the digit select outputs at pins 19, 18, 17, and 16 (i.e., DS1, DS2, DS3, and DS4 respectively). The most significant digit DS1 turns on immediately after an EOC pulse followed by the remaining digits, sequencing from the most-significant digit (MSD) to least-significant digit (LSD). An interdigit blanking time of two clock periods is included to ensure that the binary-coded decimal (BCD) data from the Q output (pins 20, 21, 22, and 23 of U2322) has settled. The multiplex cycle rate is about 4000 Hz. Relative timing between the digit select (DS) output and the EOC signals is shown in Figure 3-17.

The BCD data outputs at pins 20, 21, 22, and 23 (Q0 through Q3) of U2322 are ready to be multiplexed on immediately after an EOC pulse occurs. Three full digits of information are available during DS2, 3, and 4 output periods, while during DS1 output period, the 1/2 digit and polarity are available.

When pin 19 (DS1) goes HI, the code on the BCD data output Q2 determines polarity and output Q3 determines whether a 1 or nothing is displayed in the MSD location at (A4) on gas-discharge readout element U1650. Q2:HI=positive, LO=negative; Q3: HI=MSD of "0", LO=MSD of "1".

DIGIT-SELECT OUTPUT & INTERDIGIT BLANKING

U2323 is clocked to latch the binary-coded information from U2322 pins 20 through 23 to decoder-driver U2345. See timing diagram 3-18.

A digit is selected when the corresponding outputs from U2335A and U2322 are HI. For example, when pin 5 of U2335A is HI and pin 18 of U2322 goes HI, pin 3 of U2302 goes LO and transfers digit 2 data from U2322 pins 20, 21, 22, and 23 to U2345 inputs A,B,C, and D. Since pin 5 stays HI for 8 occurrences of DS1, data for each digit is latched into U2323 8 times before the next digit is selected.

Each time DS1 (U2322 pin 19) goes HI, U2364A is clocked. Every fourth time DS1 goes HI, U2364B is enabled, which increments the output of U2364B. The Q1 and Q2 outputs of U2364B set up addresses for U2335A and U2335B. Every eighth time DS1 goes HI, U2335A inputs are incremented. The multiplex frequency at U2322 is thus divided by 32 to allow proper operation of the readout devices. U2335A outputs are incremented in direct response to their inputs; however to provide interdigit blanking, pin 15 of U2335B is held HI for the first 2 of the 8 DS1 occurrences. This causes all outputs of U2335B to be LO, turning off all the anode driver transistors. This occurs whenever all three inputs to U2354A are LO. Blanking the display briefly between digits allows time for deionization of the gas in the readout devices to prevent appearance of streamers (blue glow) or partially lit segments .

Anode Drivers

NOTE

Gas discharge device readout sequence is in reverse order to the earlier 414s; they are multiplexed from AD4 through AD1 instead of AD1 through AD4.

The display anodes AD4 through AD1 are driven from anode driver circuits Q2337 through Q2307.

The anode drivers are driven by the DS outputs from multiplexer U2335B. The anode driver circuits are identical, so only one is described here.

When the 0 output from multiplexer U2335B goes HI, indicating that MSD (AD4) is going to be displayed, Q2336 turns on. This pulls Q2336 collector down far enough to cause Q2337 to saturate. When Q2337 saturates, the gas-discharge display anode at location AD4 is at about +165 volts.

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DESCRIPTION

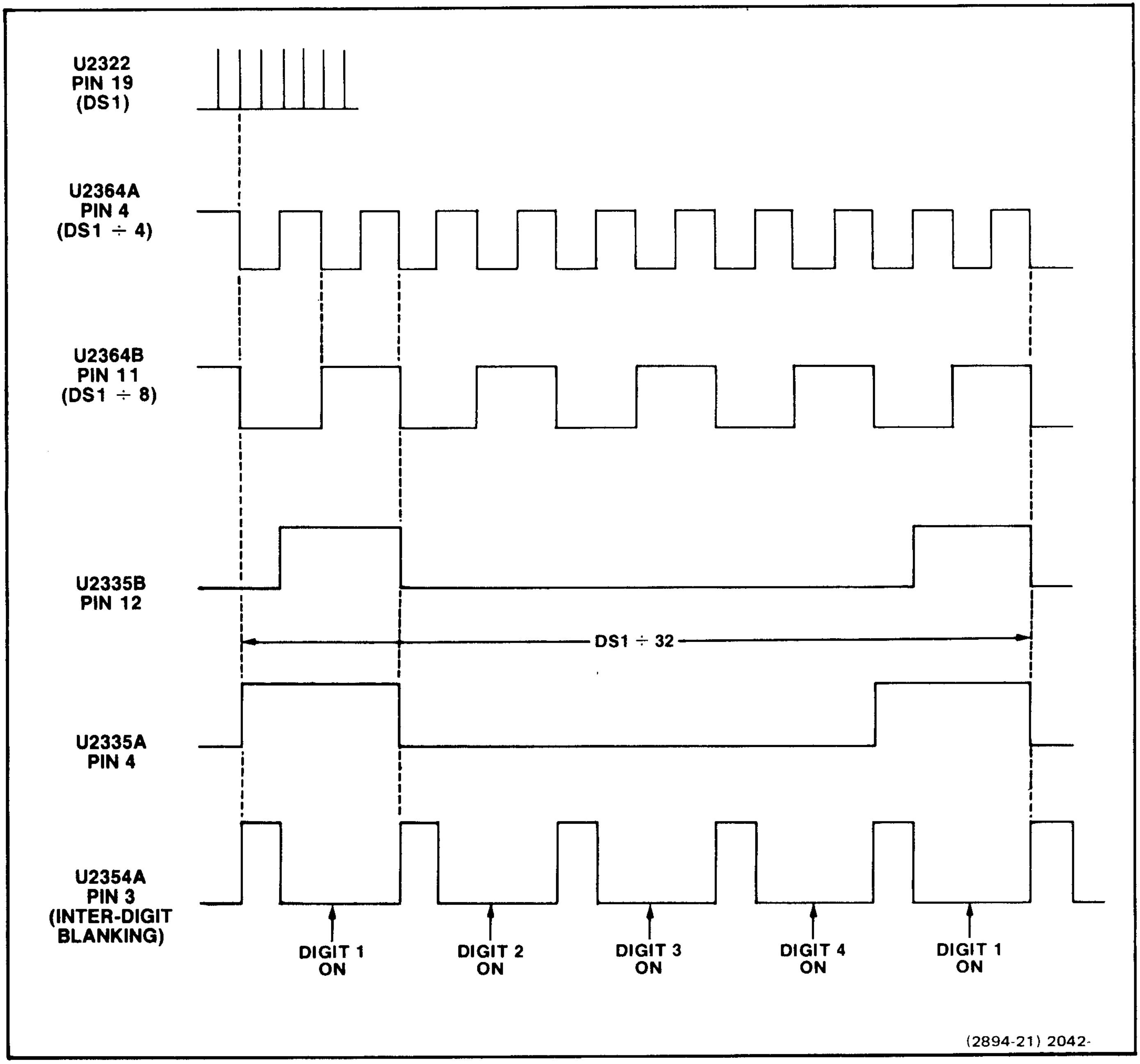


Fig. 3-18. Timing diagram for digit select and inter-digit blanking.

DESCRIPTION

Decoder-driver

Decoder-driver U2345 converts the binary-coded decimal (BCD) information from the A/D converter via the Digit Data Latch to the form required to drive the cathode segments of the 7-segment gas-discharge display.

The BCD outputs (Q_0 through Q_3) from the A/D converter are latched by U2323 and fed to the A, B, C, and D inputs of the decoder-driver. When turned on by a binary-coded number at the A, B, C, and D inputs, the segment drivers pull toward ground and current is controlled to each display segment. The current outputs are set for the appropriate ratio to light the display segments evenly since some segments are larger than others.

When the display segments are not on, the cathode segments are set at about +75 volts by resistor R2312 and resistor pack R2313A through R2313F. Resistor R2345 at the programming input (pin 3) sets the average current for all the outputs to control the display brightness.

Ripple blanking input and output operates in conjunction with the leading zero suppressiion, as described in the following discussion.

Leading-zero Suppression

Integrated circuits U2354B, U2343C, U2355A, and U2343B provide leading zero suppression. A zero is suppressed if there are no non-zero numbers to the left. The zero to the left or right of the decimal point is not suppressed.

If a 1 is displayed in digit location AD4, pin 23 (Q3) of A/D converter U2322 is LO. This condition puts a LO on the data input (pin 5) of U2355A when pin 12 of U2335B goes HI to display DS1; the clock input (pin 3 of U2355B goes HI while pin 13 of U2355A is LO. Under these conditions pin 13 of U2355A is LO, which puts a HI on the ripple blanking input (pin 5) of decoder-driver U2345 and no zero suppression (blanking) occurs.

If a 1 is not displayed in digit location AD4, pin 5 of U2355A is HI. When the output at pin 12 of U2335B clocks U2355A, it sets pin 1 HI. This puts a LO on the ripple blanking input (pin 5) of decoder-driver U2345 through inverter U2343B, causing any zero that is decoded from the A, B, C, and D inputs of U2345 to be blanked.

Certain other situations occur that require cancelling the zero suppression condition when a 1 is not displayed in digit location AD4. For example, when temperature is displayed, a LO is present at pin 8 of P2300, which puts a HI at pin 9 of AND-OR-INVERT gate U2354B.

Pin 8 of U2354B also goes HI to satisfy the AND condition when pin 6 of U2335A goes HI. Flip-flop U2355A is then reset by the HI at pin 4. Thus, pin 1 goes LO, which puts a HI at pin 5 of U2345 and no zero suppression occurs. This condition ensures that, in the temperature mode, the digit at location AD2 just prior to the decimal will always be displayed even if it is a zero. Another zero-suppression cancel command occurs when pin 7 of U2335A goes HI and resets U2355A. Thus, pin 5 of U2355A goes HI as described previously, and the last digit is never blanked even if it is a zero.

The last zero-suppression cancel command occurs when a 1 is not being displayed in location AD4 while the digit displayed in location AD3 is other than a zero. For example, if a 1 is not being displayed in location AD4, U2355A is set as described previously and all succeeding zeros would be blanked. However, if the digit displayed in location AD3 is other than a zero, the zero suppression condition is cancelled. This is accomplished when pin 11 of U2335B goes HI and the ripple blanking output from pin 4 of U2345 also goes HI,which resets flip-flop U2355A. The ripple-blanking output from 4 of U2345 is HI when the digit at location AD3 is other than a zero. With U2355A reset, pin 5 of U2345 is HI and the zero-suppression condition is cancelled.

Data Update (DU) and Sample

In normal operation, the display information is updated once per second. The clock frequency of U2322 has been set to force it to make 20 conversions per second. U2363A and U2363B divide the 20 EOC pulses down to one per second. In rapid update mode, the display information is updated 5 times per second.

DESCRIPTION

Assuming a Sample pulse has just occurred, U2363A and B will have just returned to count 0 (see Fig. 3-19), and the next EOC pulse will clock U2363A to produce a positive output at pin 12 of U2355B. This output will produce A Display Update signal at pin 9 of U2322 which causes the results of the next conversion to be latched in U2322. U2363A will continue to count EOC pulses. The tenth pulse will produce an output at pin 6 that will enable U2363. U2363B will divide by 2 (20 EOC pulses) and produce an output at pin 11. This will clock U2355B, returning its outputs to the original level. U2363A will also be returned to its original state at this time and a Sample signal will occur at P2300 pin 4.

At this point, 19 EOC pulses have occurred since the last data update signal. After one more EOC pulse, data update will occur as before (after 19 plus 1 or 20 EOC pulses). Data update occurs once per second.

This counting cycle continues unless Syst/Diast operation is selected, in which case the Sample signal output on P2300 pin 4 is used to switch the Syst/Diast selector on the Readout Conditioner board. When the selector switches the signal input to the DVM, a negative signal is also applied to the Update input of P2300. This resets the EOC counters so that two conversions are made before the display information in U2322 is updated. Eighteen more conversions are made, then another Sample signal is generated to switch the Syst/Diast selector, producing another Update input at P2300 pin 7 and the sequence is repeated. Display update signal to pin 9 of U2322 is generated by the first EOC pulse after Update occurs.

The reason for two conversions being made before data is updated is that U2322 requires one conversion to recognize a change of polarity and one to measure the input signal level at pin 3. Thus, two conversions are always required in case the signal has changed polarity.

BLANKING LOGIC

The blanking signal from the readout switching and pressure converters on the Readout Conditioner board is used in the DVM circuit to blank the readout display during systolic/diastolic operation and overrange conditions. Blank time between systolic and diastolic readings is approximately 100 ms. The time needed by the DVM circuit to make the required 2 conversions is also approximately 100 ms. U2366A and D are connected so that the longer of these two periods controls the total blank time. No blanking will occur unless the blanking signal at U2366D-13 is low.

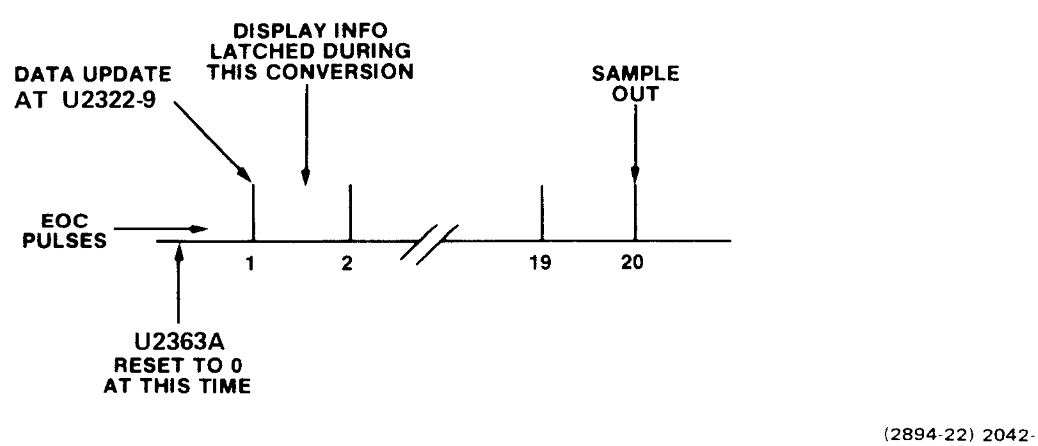


Fig. 3-19. Data update sequence.

DESCRIPTION

Sign, Decimal, and 1/2-Digit Drivers

Transistors Q2340, Q2382, Q2383, Q2373, and Q2372 are cathode-current drivers for the plus (+) and minus (-) signs, the decimal point, and the 1 displayed at digit location AD4. When the base of a driver transistor is pulled HI (to +5 volts), the driver emitter resistor sets the collector current and turns on the appropriate display cathode segment.

For example, if the display is supposed to be +1000, the binary code from the Q outputs of U2322 for a +1 display at digit location AD4 is 0100 (refer to the Truth Table in the A/D Converter discussion). The LO at Q3 (pin 23) of U2322 turns on Q2373 and lights the 1 at digit location AD4. The level at Q2 (pin 22) of U2322 determines the displayed polarity at digit location AD4. In this case, binary code 0100 at the Q outputs of U2322 means the level at Q2 is HI, which turns on Q2383 and lights the plus (+) sign. A LO at Q2 turns on Q2382 through inverter U2366B and lights the minus (-) sign at location AD4.

Transistor Q2340 disables the + and -sign cathodes at location AD4 except when temperature or pressure reading is displayed. All the cathode drivers for digit location AD4 have their emitter current control resistors returned to the collector of Q2340 instead of to ground, except the digit 1 cathode. Digit 1 normally is not lit unless a temperature above 100.0 degrees is to be displayed. Transistor Q2340 is turned on only by a HI at pin 4 of U2335 A (DS1) unless Q2340 is held off by a HI at pin 2 of P2300. Quiescently, the + and - cathode drivers for digit location AD4 are disabled until Q2340 conducts and pulls the cathode driver emitter resistors to ground.

Transistor Q2372 and associated circuitry compose a decimal point driver that is enabled when pin 6 of U2335A goes HI (i.e., a digit is selected for location AD2) and pin 8 (DP2) of P2300 is LO. The decimal point is used only for the temperature readout.

Sample Output

Q2310 provides a signal via pin 4 of P2300 to the Readout Selector Switching circuit to operate the Systolic/Diastolic selector.

+/-5 Volt Regulator

This circuit provides the + and -5 volts needed for proper operation of the IC on the DVM board. The -5 volt supply is derived from error amplifier U2396B and associated components. The +5 volt supply is derived from the +7 volt supply by unity-gain inverting amplifier U2396A and pass transistor Q2395.

Readout Supply

The readout supply uses transformer T2346 to provide -90, +75, and +165 volts to the gas-discharge readout display.

The primary of T2346 is supplied with 28 volts (p-p) picked off transformer T801 in the main power supply. The secondary voltages of T2346 (-90 and +75) are rectified and filtered in the conventional manner. The +165 volts is produced by a voltage doubler circuit (C2321, C2323, CR2323, and CR2324).

DESCRIPTION

REPLACEABLE ELECTRICAL PARTS AND SCHEMATIC CHANGES

The new DIGITAL VOLTMETER circuit board assembly consists of the following:

A7	670-6759-01	CKT BOARD ASSY:DIGITAL VOLTMETER
C2302	281-0775-00	CAP.,FXD,CER DI:0.1UF,20%,50V
C2307	285-0808-00	CAP.,FXD,PLASTIC:0.1UF,+/-10%,50V
C2308	285-0808-00	CAP.,FXD,PLASTIC:0.1UF,+/-10%,40V
C2321	283-0057-00	CAP.,FXD,CER DI:0.1UF,+80-20%,200V
C2322	283-0003-00	CAP.,FXD,CER DI:0.01UF,+80-20%,150V
C2323	283-0057-00	CAP.,FXD,CER DI:0.1UF,+80-20%,200V
C2335	283-0003-00	CAP.,FXD,CER DI:0.01UF,+80-20%,150V
C2354	281-0814-00	CAP.,FXD,CER DI:100PF,10%,100V
C2391	290-0512-00	CAP.,FXD,ELCTLT:22UF,20%,15V
C2394	290-0534-00	CAP.,FXD,ELCTLT:1UF,20%,35V
C2396	281-0813-00	CAP.,FXD,CER DI:0.047UF,20%,50V
C2397	290-0534-00	CAP.,FXD,ELCTLT:1UF,20%,35V
CR2322	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA
CR2323	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA
CR2324	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA
CR2325	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA
CR2372	152-0061-00	SEMICOND DEVICE:SILICON,175V,0.1A
CR2376	152-0061-00	SEMICOND DEVICE:SILICON,175V,0.1A
CR2378	152-0061-00	SEMICOND DEVICE:SILICON,175V,0.1A
CR2380	152-0061-00	SEMICOND DEVICE:SILICON,175V,0.1A
CR2391	152-0107-03	SEMICOND DEVICE:SILICON,400V,400MA
J620A	131-1261-00	CONTACT ELEC:CONN,F SHAPE,BRASS
Q2306	151-0444-00	TRANSISTOR:SILICON,NPN
Q2307	151-0443-00	TRANSISTOR:SILICON,PNP
Q2310	151-0188-00	TRANSISTOR:SILICON,PNP
Q2316	151-0444-00	TRANSISTOR:SILICON,NPN
Q2317	151-0443-00	TRANSISTOR:SILICON,PNP
Q2326	151-0444-00	TRANSISTOR:SILICON,NPN
Q2327	151-0443-00	TRANSISTOR:SILICON,PNP
Q2336	151-0444-00	TRANSISTOR:SILICON,NPN
Q2337	151-0443-00	TRANSISTOR:SILICON,PNP
Q2340	151-0190-00	TRANSISTOR:SILICON,NPN
Q2372	151-0347-00	TRANSISTOR:SILICON,NPN
Q2373	151-0347-00	TRANSISTOR:SILICON,NPN
Q2382	151-0347-00	TRANSISTOR:SILICON,NPN
Q2383	151-0347-00	TRANSISTOR:SILICON,NPN
Q2388	151-0301-00	TRANSISTOR:SILICON,PNP
R2301	321-0249-09	RES.,FXD,FILM:3.83K OHM,1%,0.125W
R2302	311-1861-00	RES.,VAR,NONWIR:TRMR,1K OHM,0.5W
R2303	321-1211-09	RES.,FXD,FILM:1.56K OHM,1%,0.125W

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DESCRIPTION		
R2304	315-0106-00	RES.,FXD,CMPSN:10M OHM,5%,0.25W
R2305	315-0103-00	RES,.FXD,CMPSN:10K OHM,5%,0.25W
R2307	315-0823-00	RES.,FXD,CMPSN:82K OHM,5%,0.25W
R2309	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W
R2312	307-0549-00	RES.,NETWORK,FXD,FI:(7)1M OHM,5%,1.0W
R2313	307-0549-00	RES.,NETWORK,FXD,FI:(7)1M OHM,5%,1.0W
R2322	315-0106-00	RES.,FXD,CMPSN:10M OHM,5%,0.25W
R2323	315-0106-00	RES.,FXD,CMPSN:10M OHM,5%,0.25W
R2325	315-0304-00	RES.,FXD,CMPSN:300K OHM,5%,0.25W
R2333	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R2334	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R2336	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R2337	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R2339	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R2340	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R2342	315-0104-00	RES.,FXD,CMPSN:100K OHM,5%,0.25W
R2343	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R2345	315-0472-00	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W
R2350	315-0514-00	RES.,FXD,CMPSN:510 OHM,5%,0.25W
R2351	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R2353	315-0103-00	RES,.FXD,CMPSN:10K OHM,5%,0.25W
R2354	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R2355	315-0514-00	RES.,FXD,CMPSN:510 OHM,5%,0.25W
R2356	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R2357	315-0103-00	RES.,FXD,CMPSN:10K OHM,5%,0.25W
R2359	315-0514-00	RES.,FXD,CMPSN:510K OHM,5%,0.25W
R2360	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R2361	315-0103-00	RES,.FXD,CMPSN:10K OHM,5%,0.25W
R2363	315-0514-00	RES.,FXD,CMPSN:510 OHM,5%,0.25W
R2364	315-0153-00	RES.,FXD,CMPSN:15K OHM,5%,0.25W
R2365	315-0103-00	RES,.FXD,CMPSN:10K OHM,5%,0.25W
R2370	315-0275-00	RES.,FXD,CMPSN:2.7M OHM,5%,0.25W
R2372	315-0275-00	RES.,FXD,CMPSN:2.7M OHM,5%,0.25W
R2374	315-0752-00	RES.,FXD,CMPSN:7.5K OHM,5%,0.25W
R2375	315-0105-00	RES.,FXD,CMPSN:1M OHM,5%,0.25W
R2376	315-0272-00	RES.,FXD,CMPSN:2.7K OHM,5%,0.25W
R2381	315-0682-00	RES.,FXD,CMPSN:6.8K OHM,5%,0.25W
R2383	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
R2384	315-0362-00	RES.,FXD,CMPSN:3.6K OHM,5%,0.25W
R2385	315-0473-00	RES.,FXD,CMPSN:47K OHM,5%,0.25W
R2387	315-0203-00	RES.,FXD,CMPSN:20K OHM,5%,0.25W
R2388	315-0103-00	RES,.FXD,CMPSN:10K OHM,5%,0.25W
R2391	321-0816-03	RES.,FXD,FILM:5.0K OHM,0.25%,0.125W
R2393	315-0392-00	RES.,FXD,CMPSN:3.9K OHM,5%,0.25W
R2394	321-0269-00	RES.,FXD,FILM:6.19K OHM,1%,0.125W
R2395	315-0122-00	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W
R2396	321-0816-03	RES.,FXD,FILM:5.0K OHM,0.25%,0.125W
R2397	321-0816-03	RES.,FXD,FILM:5.0K OHM,0.25%,0.125W

DESCRIPTION

T2385	120-1042-00	XFMR,PWR,STU:READOUT,POT CORE
U2302	156-0753-01	MICROCIRCUIT,DI:EXPAND 4-W 2-INPUT,AOI,GATE
U2322	156-1118-00	MICROCIRCUIT,LI:ANALOG DIGITAL CONVERTER
U2323	156-0800-01	MICROCIRCUIT,DI:QUAD LATCH
U2333	156-0330-02	MICROCIRCUIT,DI:HEX BUFFER
U2335	156-1368-00	MICROCIRCUIT,DI:DUAL BIN 1 OF 4 DCDR/DMUX
U2343	156-0494-02	MICROCIRCUIT,DI:HEX INVERTER/BUFFER,SEL
U2345	156-0284-03	MICROCIRCUIT,DI:BCD-7 SEG DECODER/DRIVER
U2354	156-0925-02	MICROCIRCUIT,DI:DUAL 2 WIDE 2INP AOI
U2355	156-0366-02	MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHECKED
U2363	156-0752-01	MICROCIRCUIT,DI:DUAL BCD UP COUNTER
U2364	156-0579-02	MICROCIRCUIT,DI:DUAL 4 BIT BIN COUNTER
U2366	156-0350-05	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE
U2387	156-1436-00	MICROCIRCUIT,LI:VOLTAGE REF
U2396	156-0158-07	MICROCIRCUIT,LI:DUAL OPNL AMPL,CHECKED

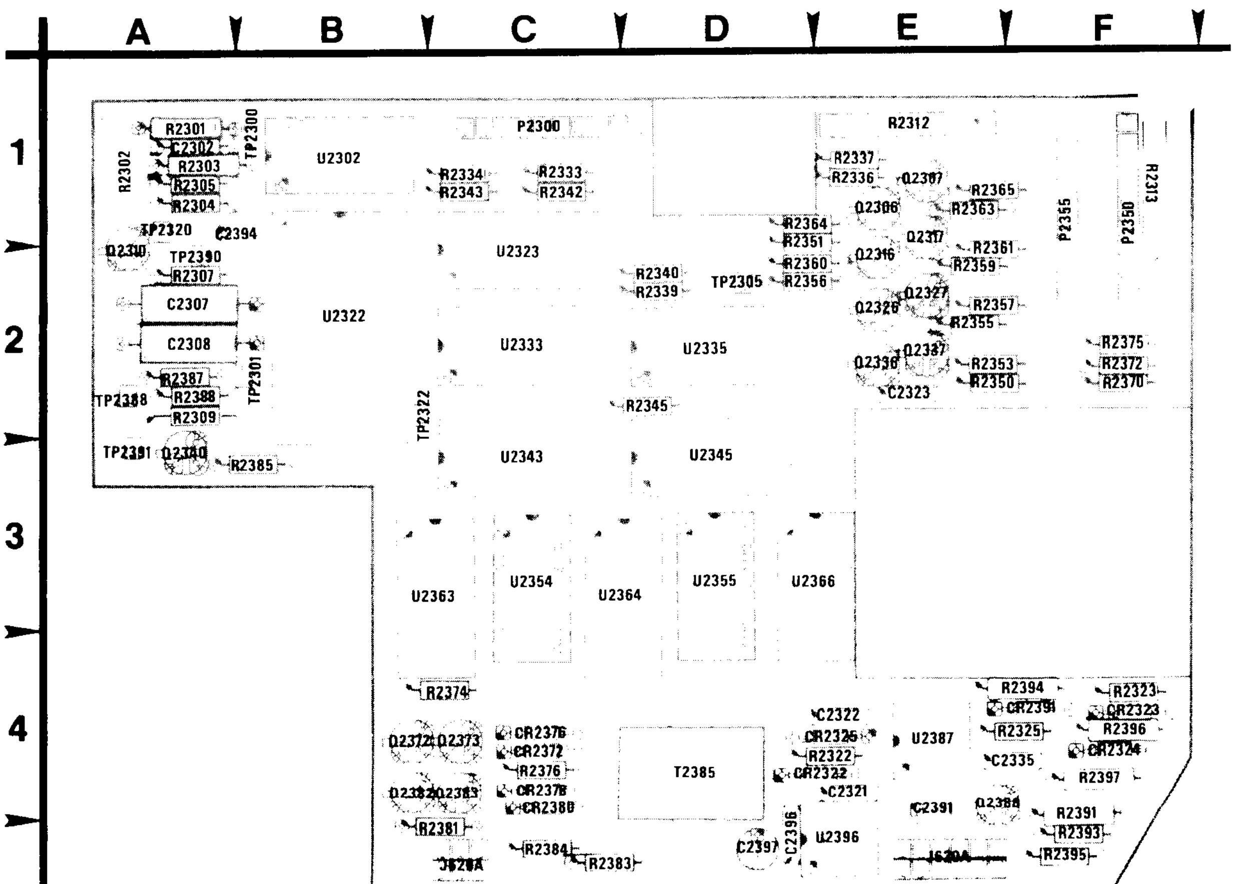
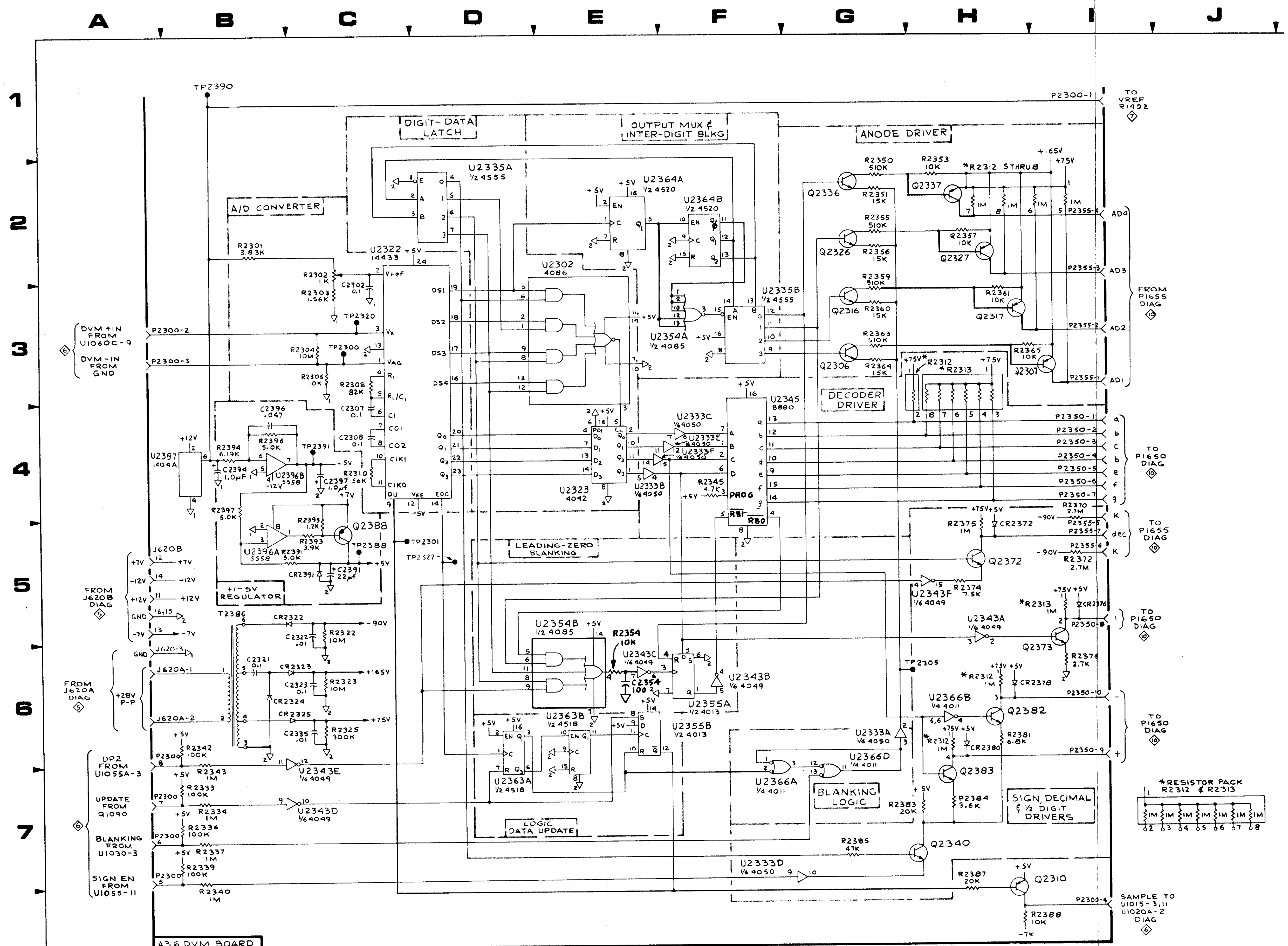


Fig. 8-16. A7--Digital Voltmeter board component locations SN B100000 & up.


DIGIT-DATA LATCH
OUTPUT MUX & INTER-DIGIT BLKG
ANODE DRIVER
A/D CONVERTER
DECODER DRIVER
LEADING-ZERO BLANKING
+/- 5V REGULATOR
BLANKING LOGIC
LOGIC DATA UPDATE
SIGN, DECIMAL & ½ DIGIT DRIVERS
A36 DVM BOARD
*RESISTOR PACK R2312 & R2313